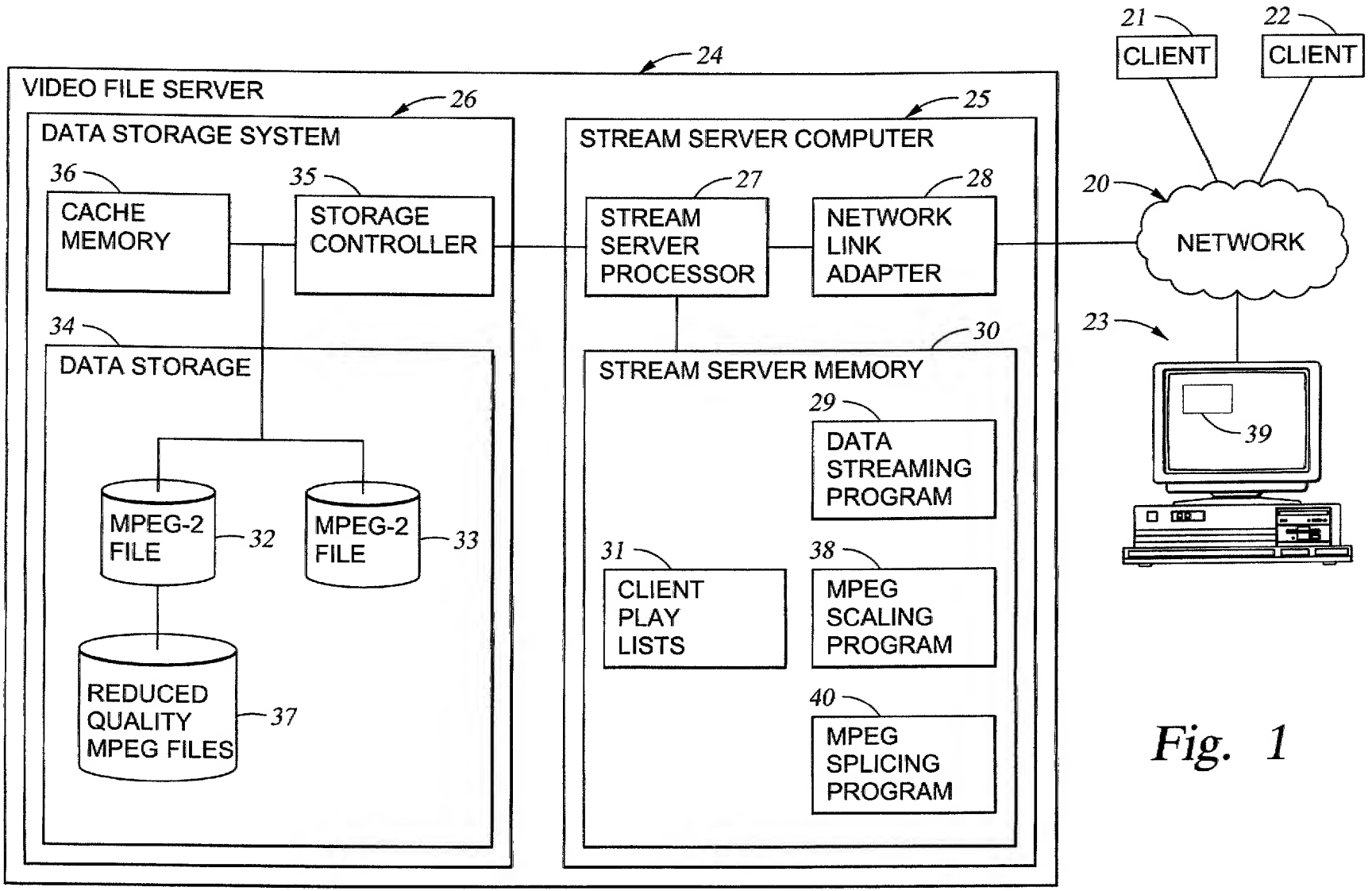
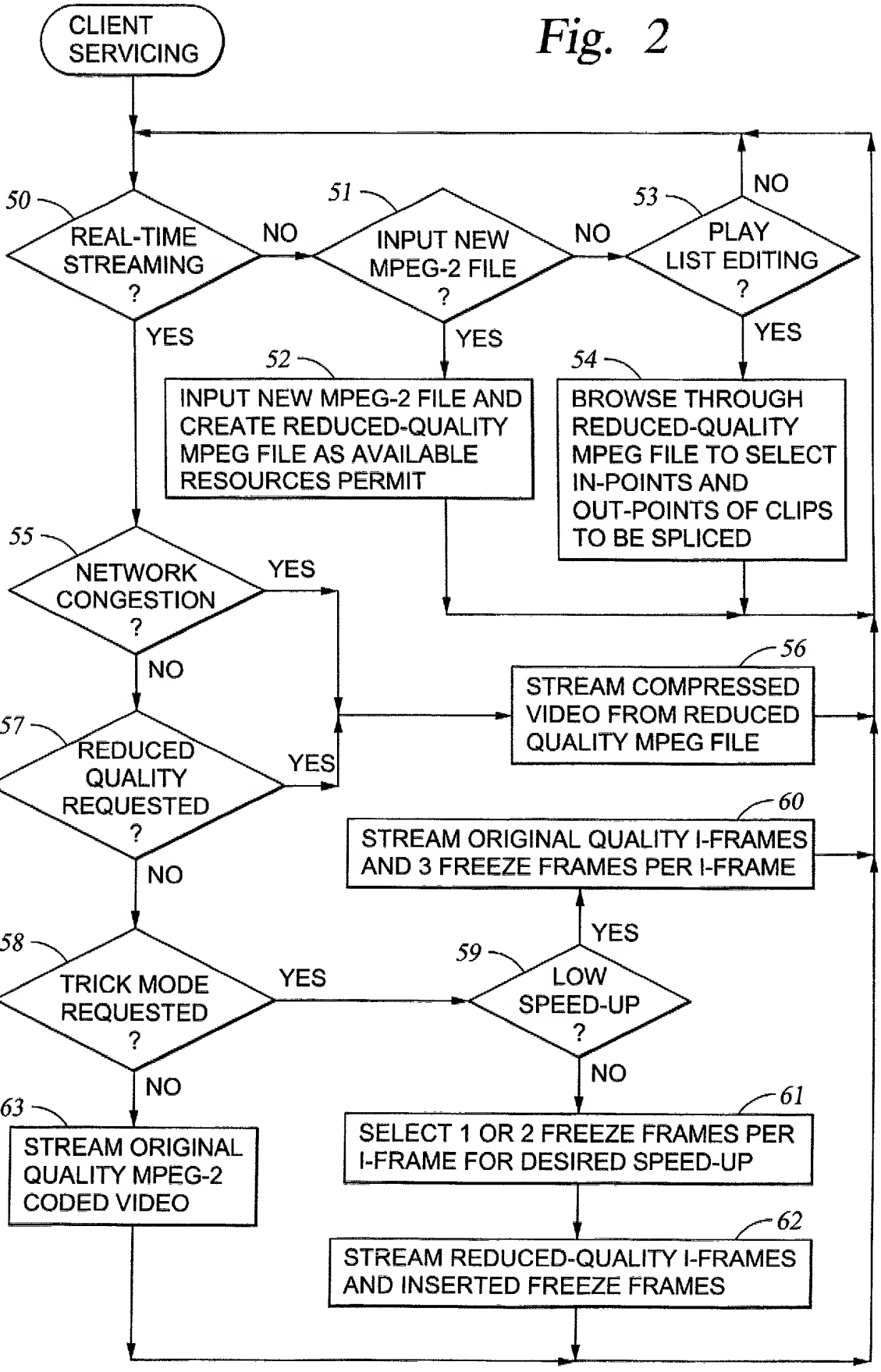

21
CLIENT
22
CLIENT
24
VIDEO FILE SERVER
26
DATA STORAGE SYSTEM
25
STREAM SERVER COMPUTER
36
CACHE MEMORY
35
STORAGE CONTROLLER
27
STREAM SERVER PROCESSOR
28
NETWORK LINK ADAPTER
20
NETWORK
34
DATA STORAGE
30
STREAM SERVER MEMORY
29
DATA STREAMING PROGRAM
MPEG-2 FILE
32
MPEG-2 FILE
33
23
39
31
CLIENT PLAY LISTS
38
MPEG SCALING PROGRAM
REDUCED QUALITY MPEG FILES
37
40
MPEG SPLICING PROGRAM

Fig. 1

5,955,977

Fig. 2



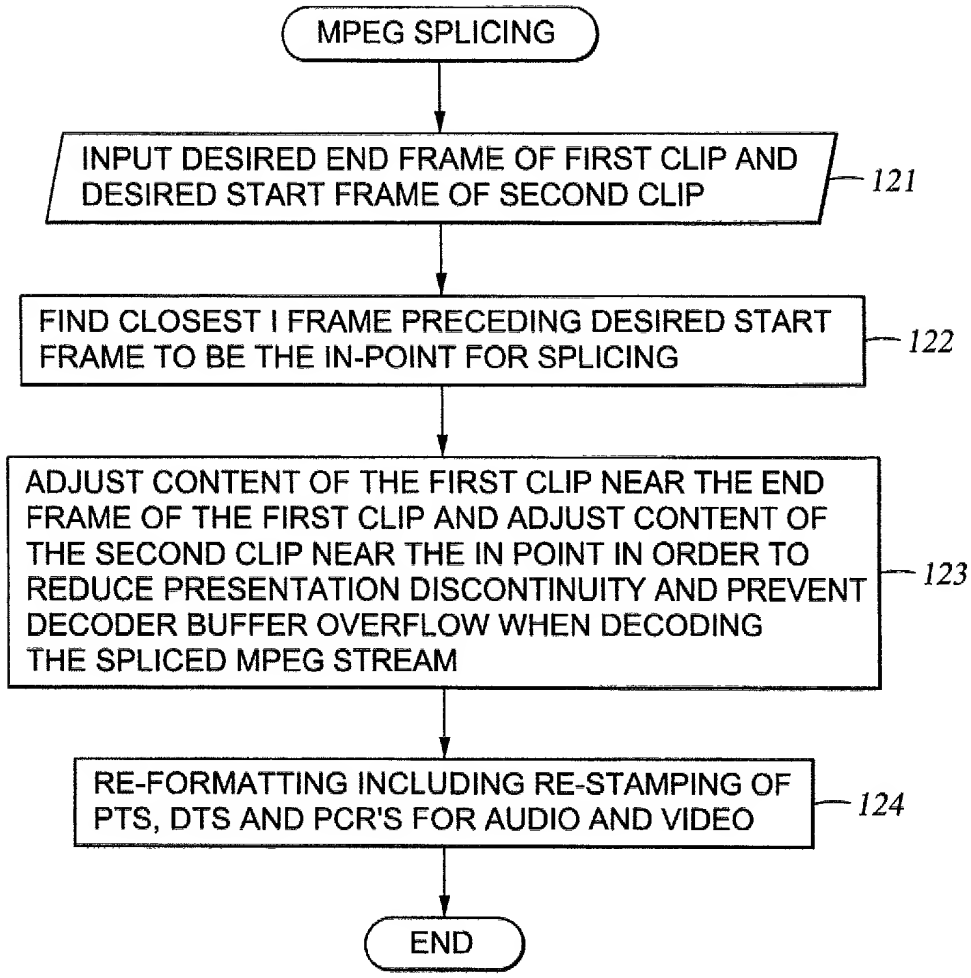

MPEG SPLICING
INPUT DESIRED END FRAME OF FIRST CLIP AND DESIRED START FRAME OF SECOND CLIP
121
FIND CLOSEST I FRAME PRECEDING DESIRED START FRAME TO BE THE IN-POINT FOR SPLICING
122
ADJUST CONTENT OF THE FIRST CLIP NEAR THE END FRAME OF THE FIRST CLIP AND ADJUST CONTENT OF THE SECOND CLIP NEAR THE IN POINT IN ORDER TO REDUCE PRESENTATION DISCONTINUITY AND PREVENT DECODER BUFFER OVERFLOW WHEN DECODING THE SPLICED MPEG STREAM
123
RE-FORMATTING INCLUDING RE-STAMPING OF PTS, DTS AND PCR'S FOR AUDIO AND VIDEO
124
END

Fig. 3

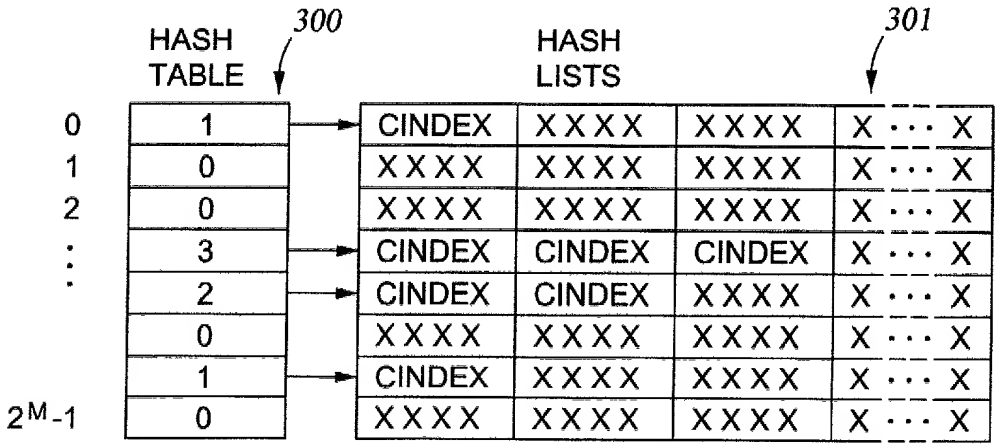

HASH TABLE
300
HASH LISTS
301
0
1
2
3
2
0
1
2M-1
1
0
0
3
2
0
1
0
CINDEX XXXX XXXX X ··· X
XXXX XXXX XXXX X ··· X
XXXX XXXX XXXX X ··· X
CINDEX CINDEX CINDEX X ··· X
CINDEX CINDEX XXXX X ··· X
XXXX XXXX XXXX X ··· X
CINDEX XXXX XXXX X ··· X
XXXX XXXX XXXX X ··· X

Fig. 18

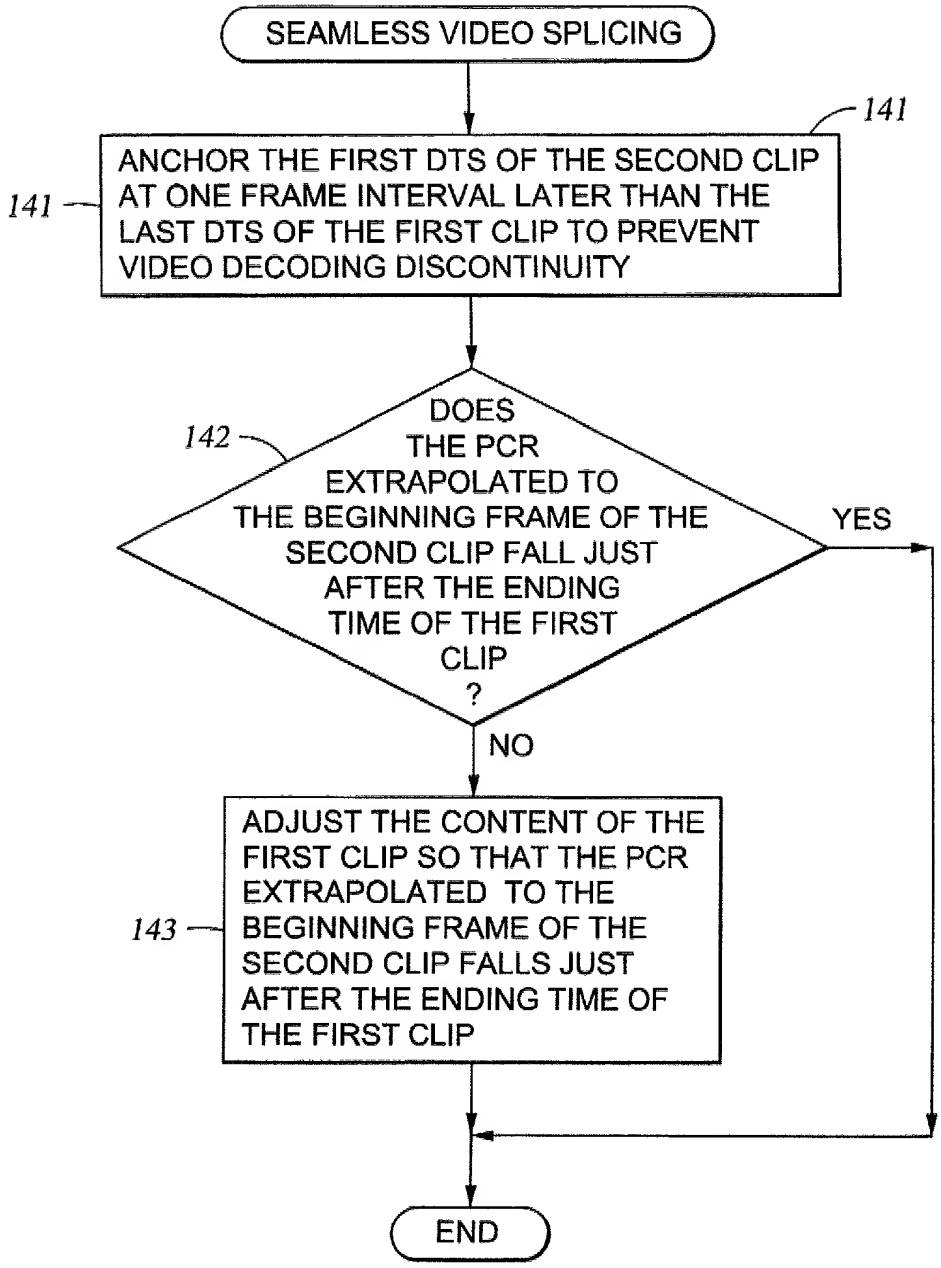

SEAMLESS VIDEO SPLICING
141
ANCHOR THE FIRST DTS OF THE SECOND CLIP AT ONE FRAME INTERVAL LATER THAN THE LAST DTS OF THE FIRST CLIP TO PREVENT VIDEO DECODING DISCONTINUITY
141
142
DOES THE PCR EXTRAPOLATED TO THE BEGINNING FRAME OF THE SECOND CLIP FALL JUST AFTER THE ENDING TIME OF THE FIRST CLIP ?
YES
NO
143
ADJUST THE CONTENT OF THE FIRST CLIP SO THAT THE PCR EXTRAPOLATED TO THE BEGINNING FRAME OF THE SECOND CLIP FALLS JUST AFTER THE ENDING TIME OF THE FIRST CLIP
END

Fig. 4

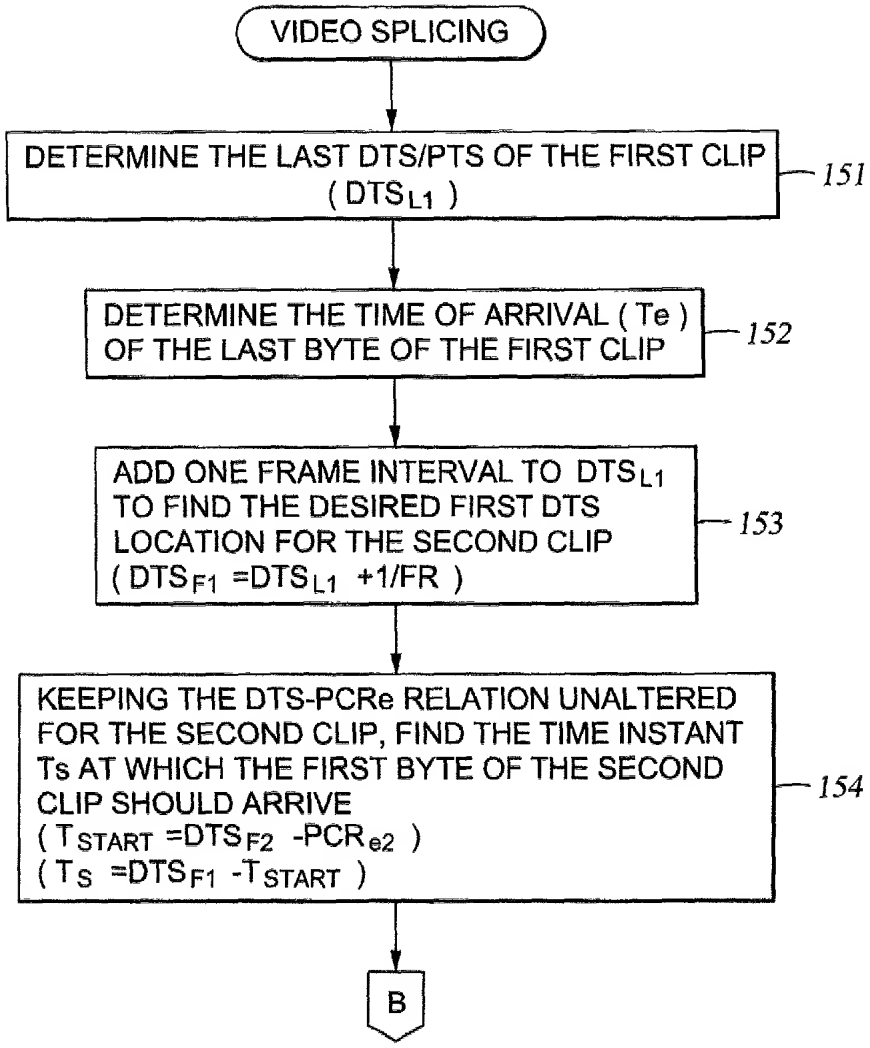

VIDEO SPLICING
DETERMINE THE LAST DTS/PTS OF THE FIRST CLIP (DTS_{L1})
151
DETERMINE THE TIME OF ARRIVAL (Te) OF THE LAST BYTE OF THE FIRST CLIP
152
ADD ONE FRAME INTERVAL TO DTS_{L1} TO FIND THE DESIRED FIRST DTS LOCATION FOR THE SECOND CLIP (DTS_{F1} =DTS_{L1} +1/FR)
153
KEEPING THE DTS-PCRe RELATION UNALTERED FOR THE SECOND CLIP, FIND THE TIME INSTANT Ts AT WHICH THE FIRST BYTE OF THE SECOND CLIP SHOULD ARRIVE
(T_{START} =DTS_{F2} -PCR_{e2})
(T_S =DTS_{F1} -T_{START})
154
B

Fig. 5

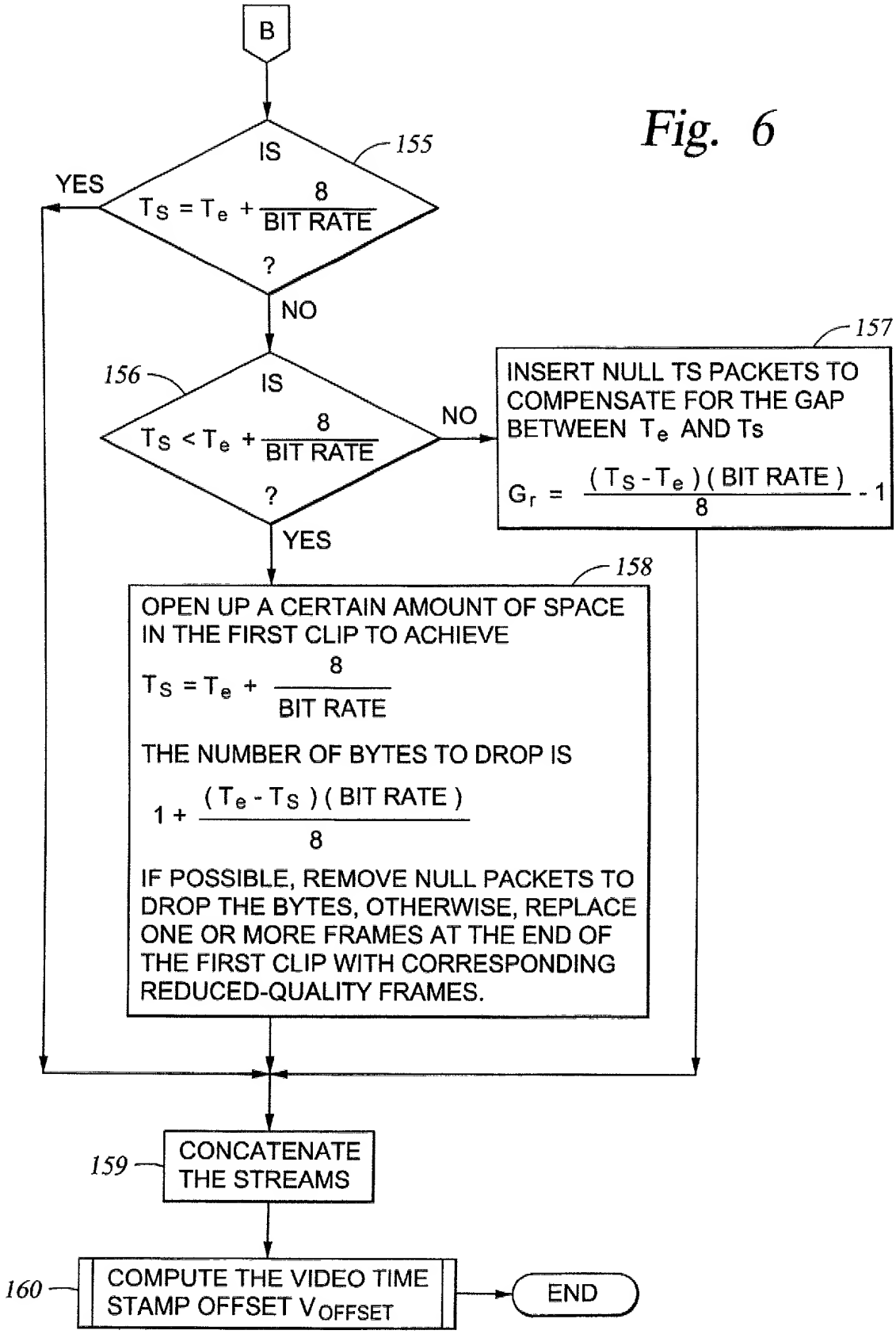


Fig. 6

05552625.05460

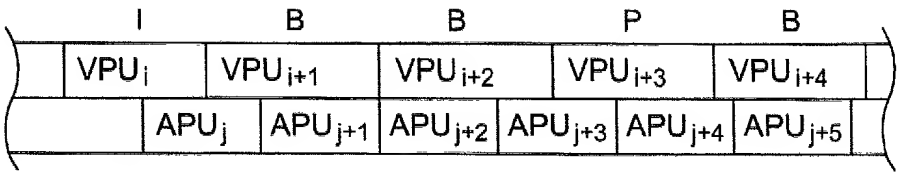


Fig. 7

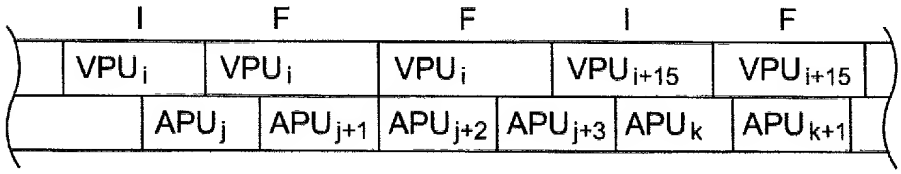


Fig. 8

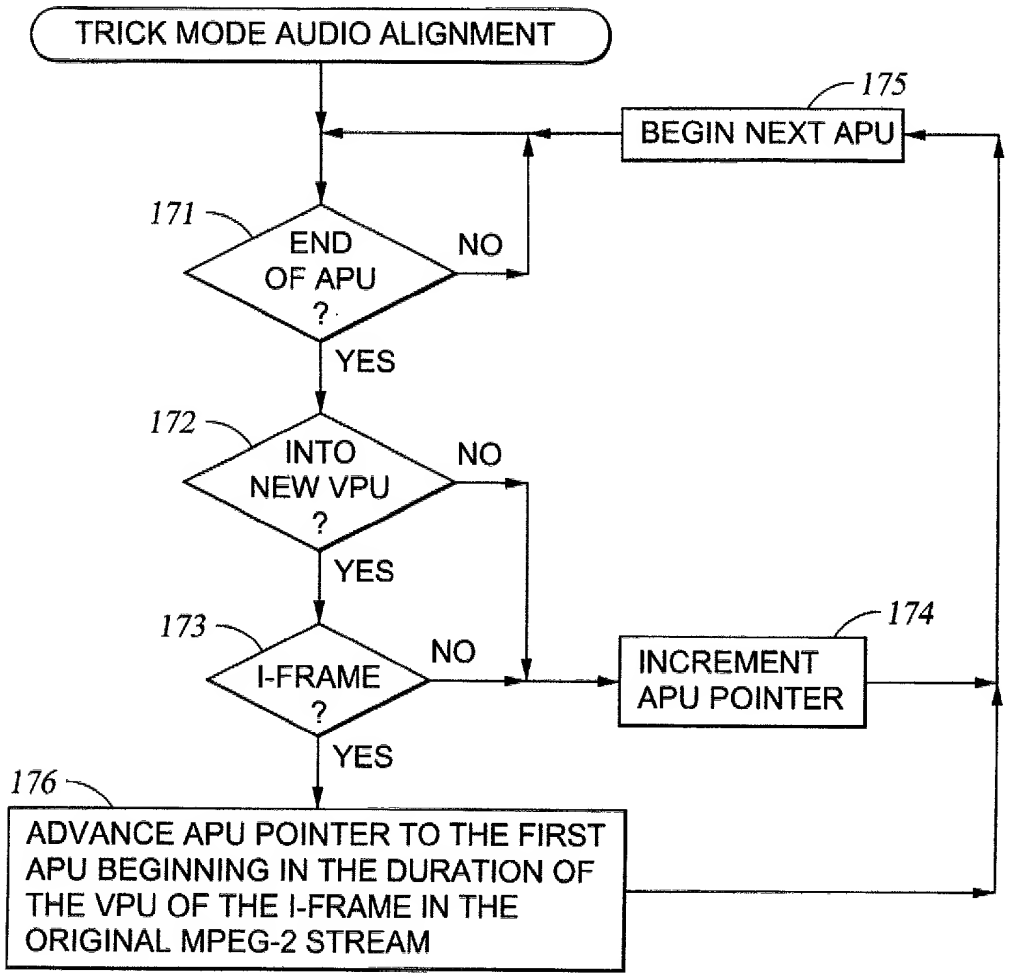


Fig. 9

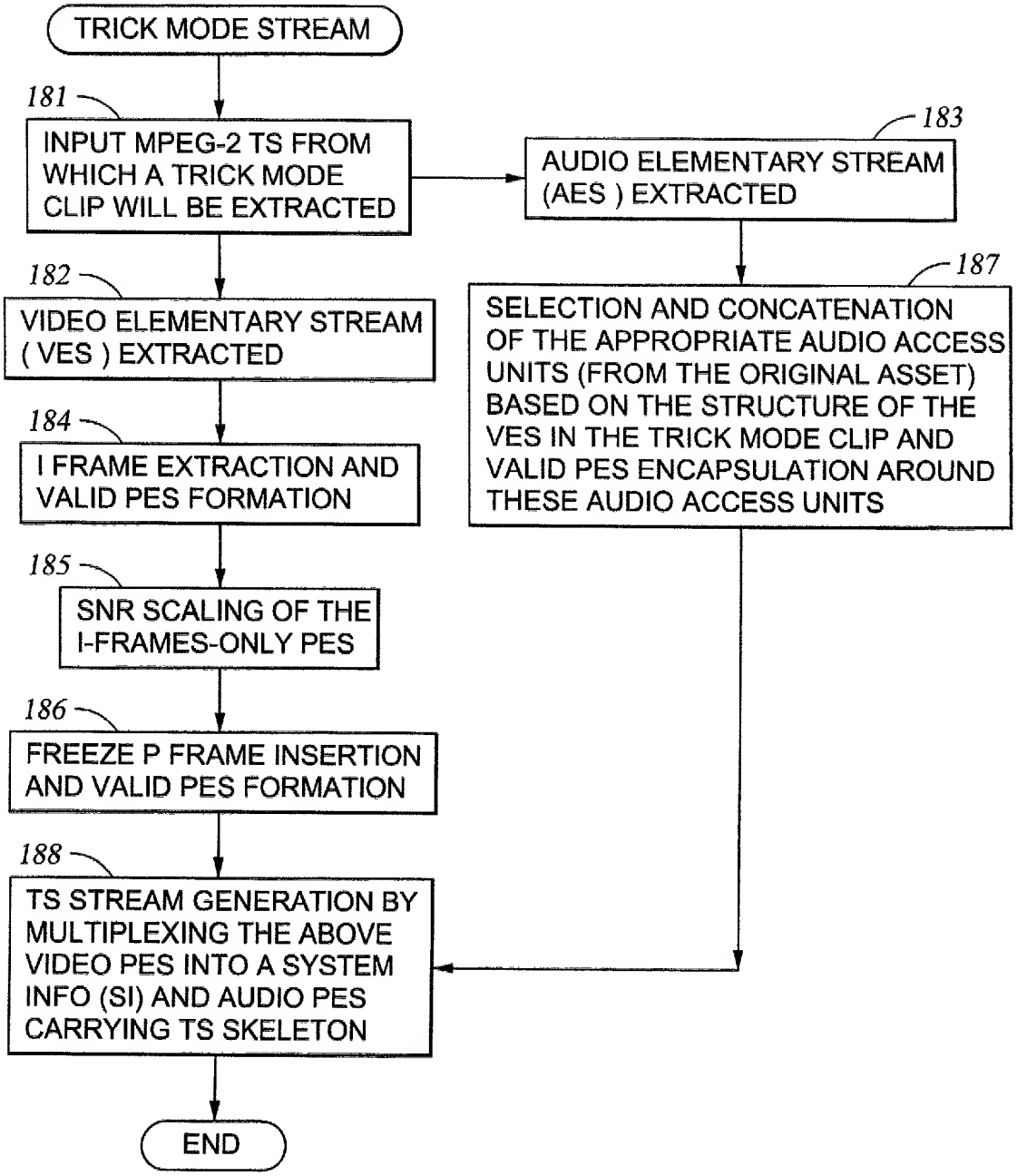

TRICK MODE STREAM
181
INPUT MPEG-2 TS FROM WHICH A TRICK MODE CLIP WILL BE EXTRACTED
183
AUDIO ELEMENTARY STREAM (AES) EXTRACTED
182
VIDEO ELEMENTARY STREAM (VES) EXTRACTED
187
SELECTION AND CONCATENATION OF THE APPROPRIATE AUDIO ACCESS UNITS (FROM THE ORIGINAL ASSET) BASED ON THE STRUCTURE OF THE VES IN THE TRICK MODE CLIP AND VALID PES ENCAPSULATION AROUND THESE AUDIO ACCESS UNITS
184
I FRAME EXTRACTION AND VALID PES FORMATION
185
SNR SCALING OF THE I-FRAMES-ONLY PES
186
FREEZE P FRAME INSERTION AND VALID PES FORMATION
188
TS STREAM GENERATION BY MULTIPLEXING THE ABOVE VIDEO PES INTO A SYSTEM INFO (SI) AND AUDIO PES CARRYING TS SKELETON
END

Fig. 10

TOSTCO 5225660

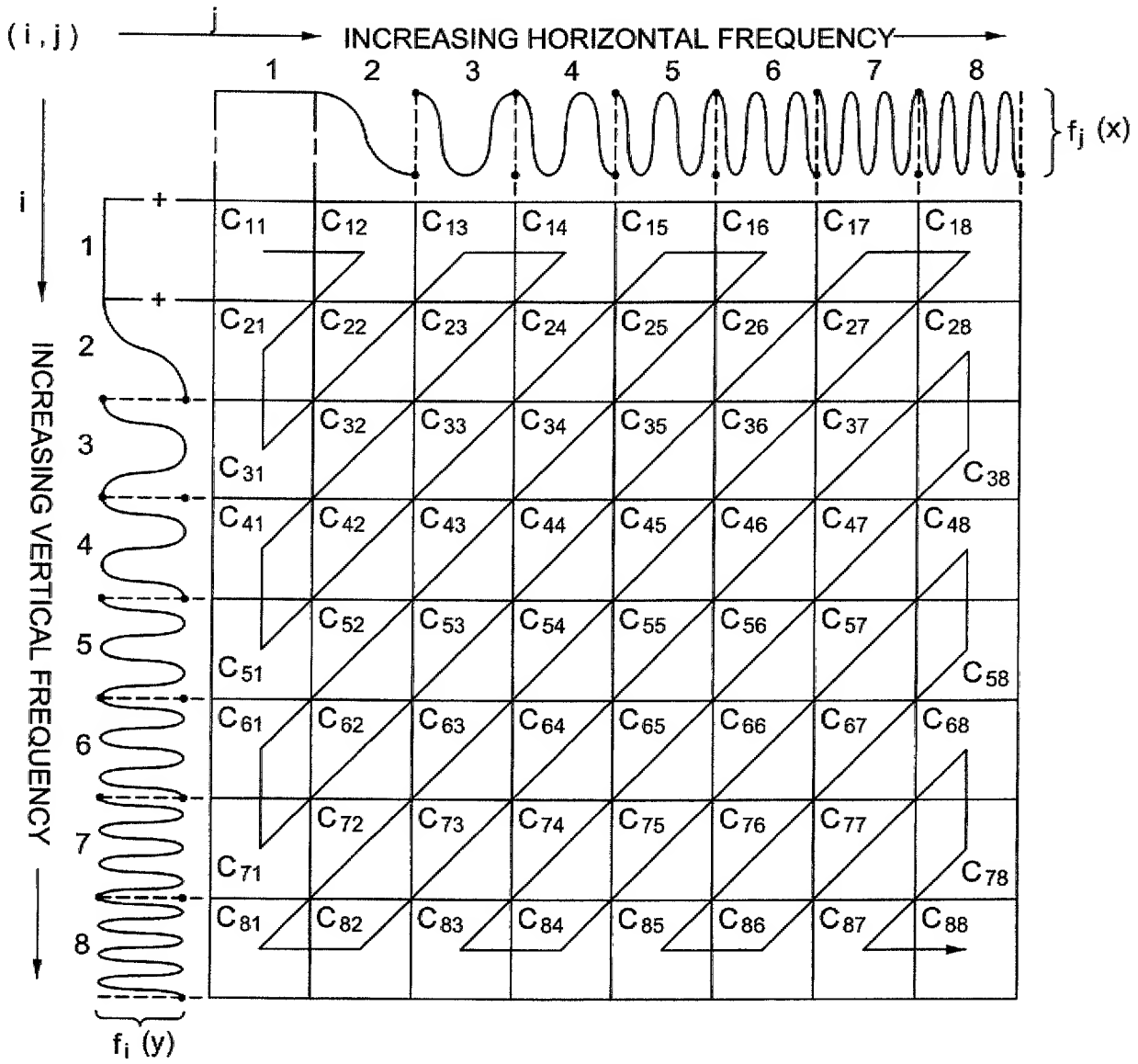


Fig. 11
(PRIOR ART)

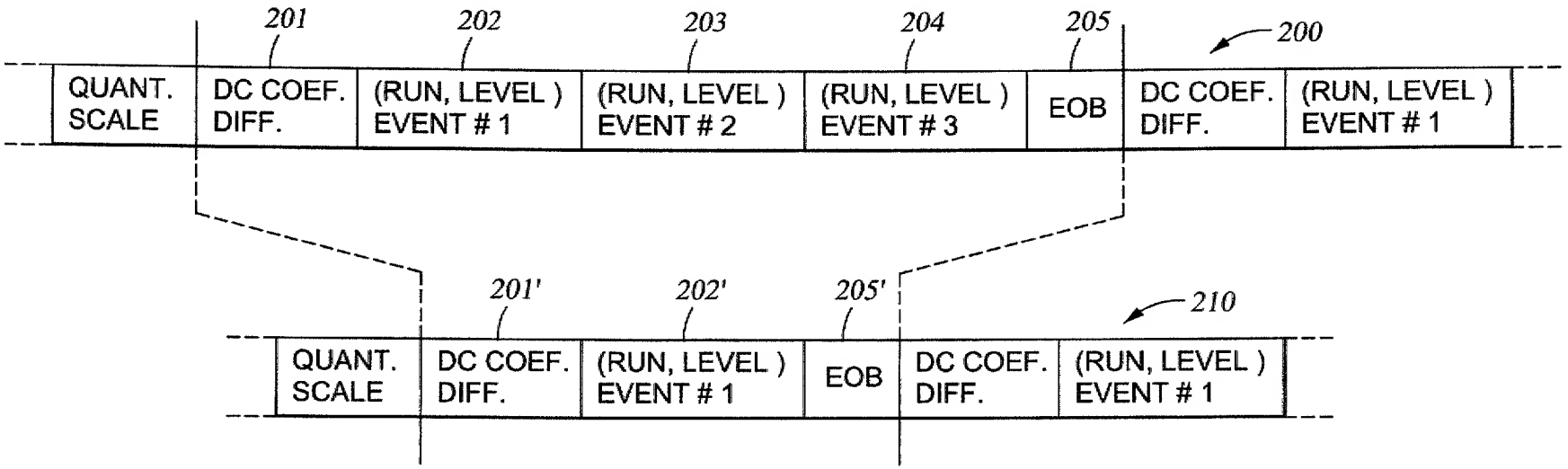

201
202
203
204
205
200
QUANT. SCALE
DC COEF. DIFF.
(RUN, LEVEL) EVENT # 1
(RUN, LEVEL) EVENT # 2
(RUN, LEVEL) EVENT # 3
EOB
DC COEF. DIFF.
(RUN, LEVEL) EVENT # 1
201'
202'
205'
210
QUANT. SCALE
DC COEF. DIFF.
(RUN, LEVEL) EVENT # 1
EOB
DC COEF. DIFF.
(RUN, LEVEL) EVENT # 1

Fig. 12

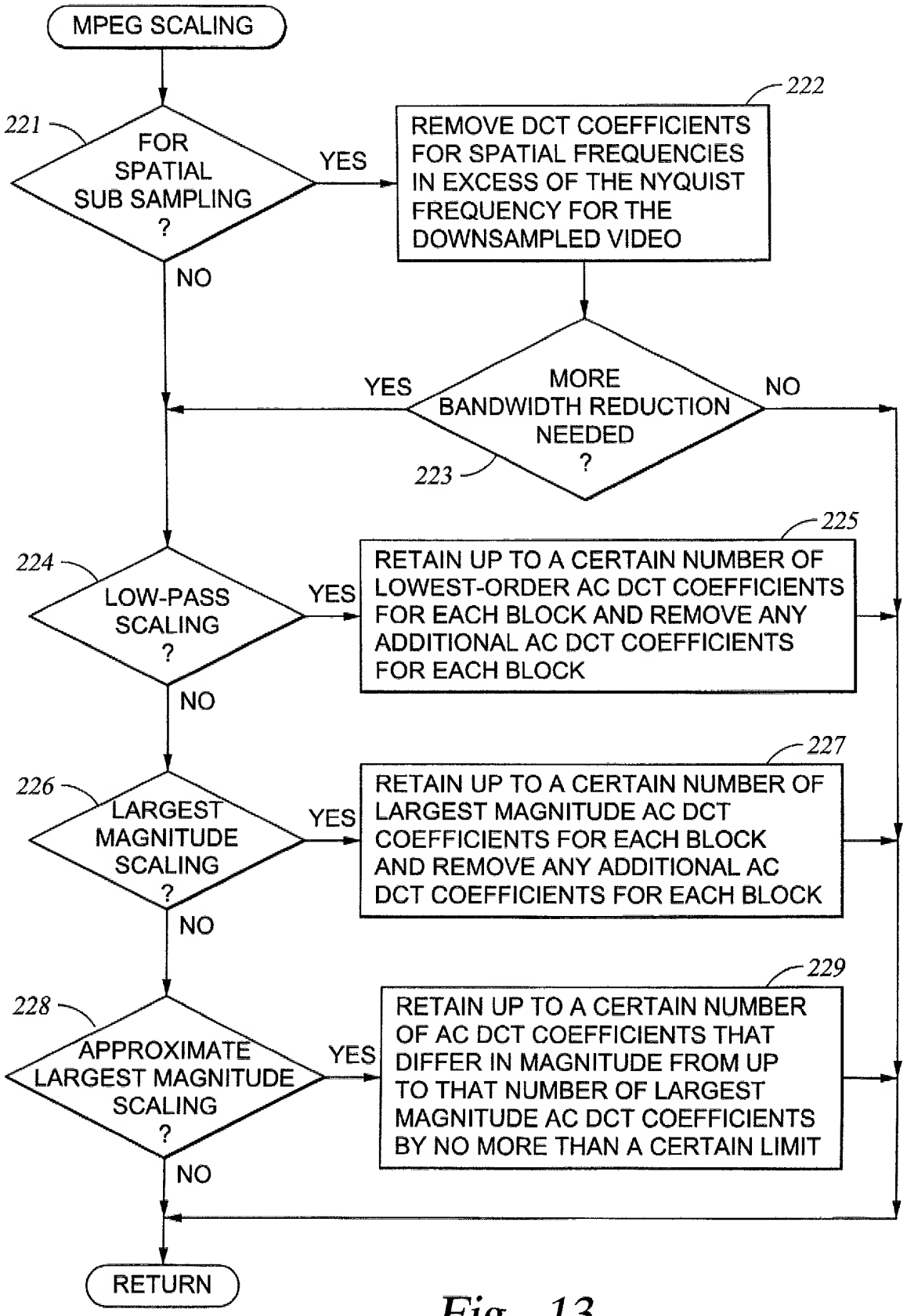

MPEG SCALING
221
FOR SPATIAL SUB SAMPLING ?
YES
222
REMOVE DCT COEFFICIENTS FOR SPATIAL FREQUENCIES IN EXCESS OF THE NYQUIST FREQUENCY FOR THE DOWNSAMPLED VIDEO
NO
YES
MORE BANDWIDTH REDUCTION NEEDED ?
223
NO
224
LOW-PASS SCALING ?
YES
225
RETAIN UP TO A CERTAIN NUMBER OF LOWEST-ORDER AC DCT COEFFICIENTS FOR EACH BLOCK AND REMOVE ANY ADDITIONAL AC DCT COEFFICIENTS FOR EACH BLOCK
NO
226
LARGEST MAGNITUDE SCALING ?
YES
227
RETAIN UP TO A CERTAIN NUMBER OF LARGEST MAGNITUDE AC DCT COEFFICIENTS FOR EACH BLOCK AND REMOVE ANY ADDITIONAL AC DCT COEFFICIENTS FOR EACH BLOCK
NO
228
APPROXIMATE LARGEST MAGNITUDE SCALING ?
YES
229
RETAIN UP TO A CERTAIN NUMBER OF AC DCT COEFFICIENTS THAT DIFFER IN MAGNITUDE FROM UP TO THAT NUMBER OF LARGEST MAGNITUDE AC DCT COEFFICIENTS BY NO MORE THAN A CERTAIN LIMIT
NO
RETURN

Fig. 13

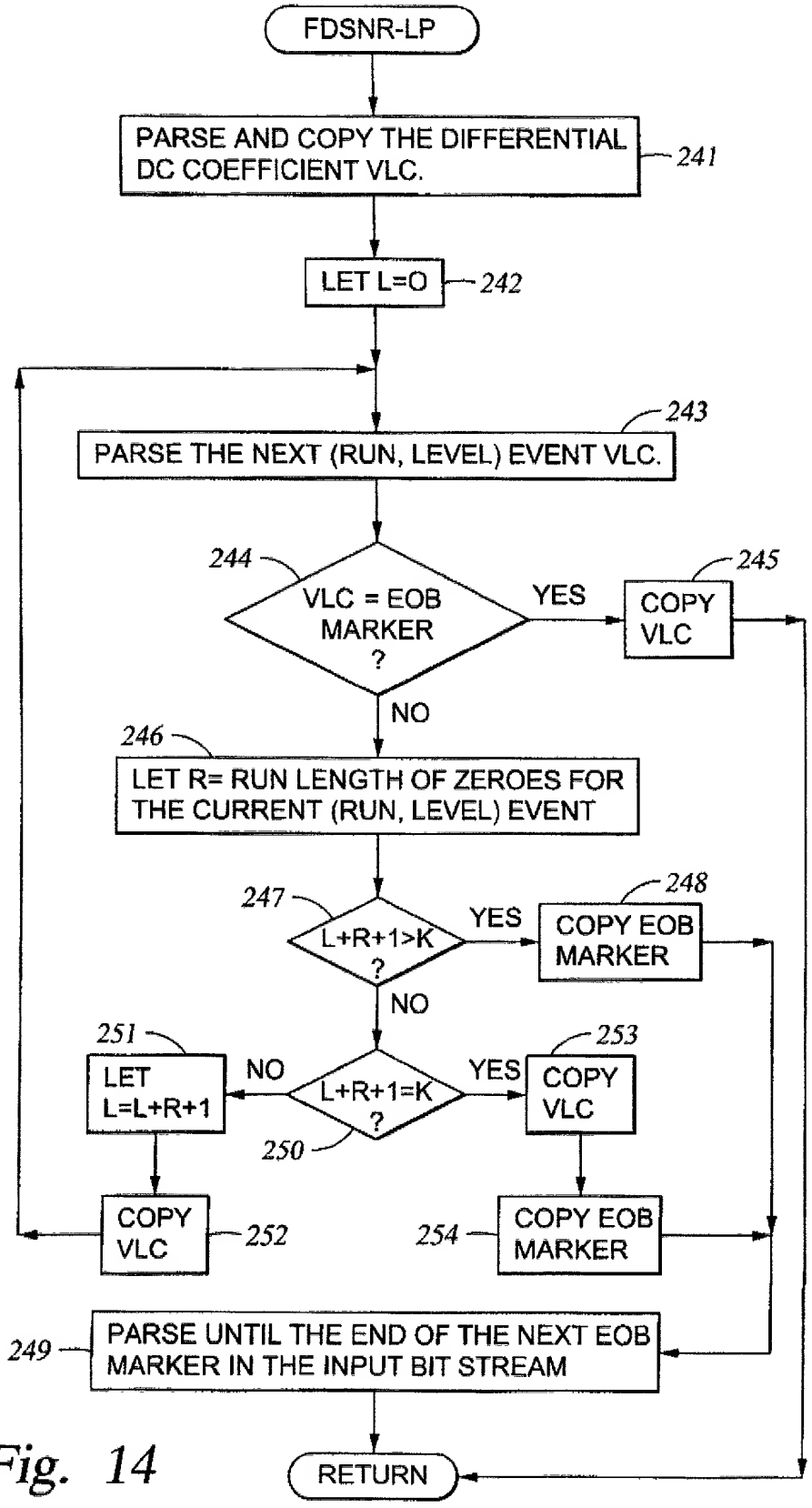

FDSNR-LP
PARSE AND COPY THE DIFFERENTIAL DC COEFFICIENT VLC.
241
LET L=O
242
243
PARSE THE NEXT (RUN, LEVEL) EVENT VLC.
244
VLC = EOB MARKER ?
YES
245
COPY VLC
NO
246
LET R= RUN LENGTH OF ZEROES FOR THE CURRENT (RUN, LEVEL) EVENT
247
L+R+1>K ?
YES
248
COPY EOB MARKER
NO
251
LET L=L+R+1
NO
L+R+1=K ?
YES
253
COPY VLC
250
COPY VLC
252
254
COPY EOB MARKER
249
PARSE UNTIL THE END OF THE NEXT EOB MARKER IN THE INPUT BIT STREAM
RETURN

Fig. 14

Patent Application Publication

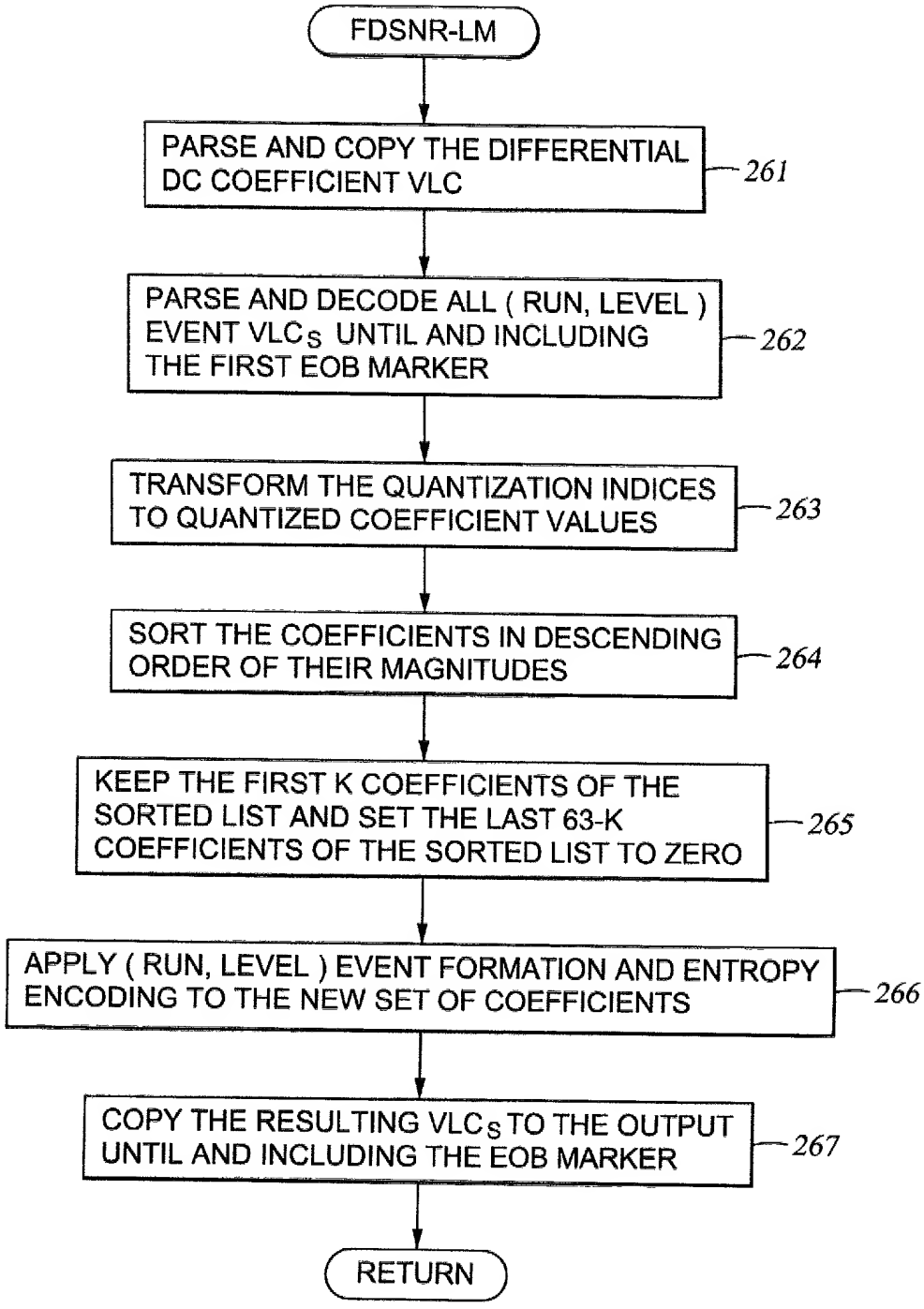


Fig. 15

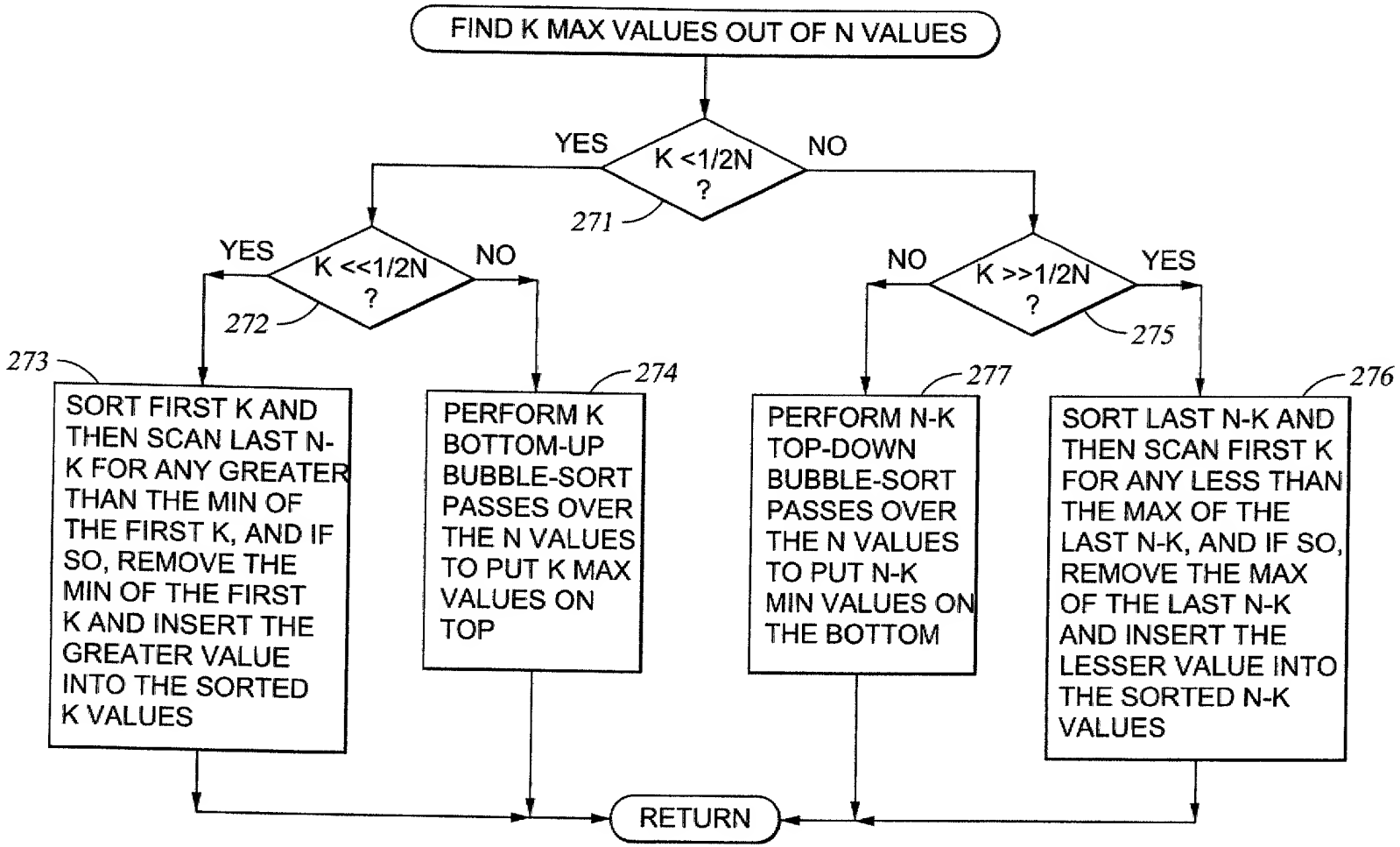

FIND K MAX VALUES OUT OF N VALUES
K <1/2N ?
271
YES
NO
K <<1/2N ?
272
YES
NO
K >>1/2N ?
275
NO
YES
273
SORT FIRST K AND THEN SCAN LAST N-K FOR ANY GREATER THAN THE MIN OF THE FIRST K, AND IF SO, REMOVE THE MIN OF THE FIRST K AND INSERT THE GREATER VALUE INTO THE SORTED K VALUES
274
PERFORM K BOTTOM-UP BUBBLE-SORT PASSES OVER THE N VALUES TO PUT K MAX VALUES ON TOP
277
PERFORM N-K TOP-DOWN BUBBLE-SORT PASSES OVER THE N VALUES TO PUT N-K MIN VALUES ON THE BOTTOM
276
SORT LAST N-K AND THEN SCAN FIRST K FOR ANY LESS THAN THE MAX OF THE LAST N-K, AND IF SO, REMOVE THE MAX OF THE LAST N-K AND INSERT THE LESSER VALUE INTO THE SORTED N-K VALUES
RETURN

Fig. 16

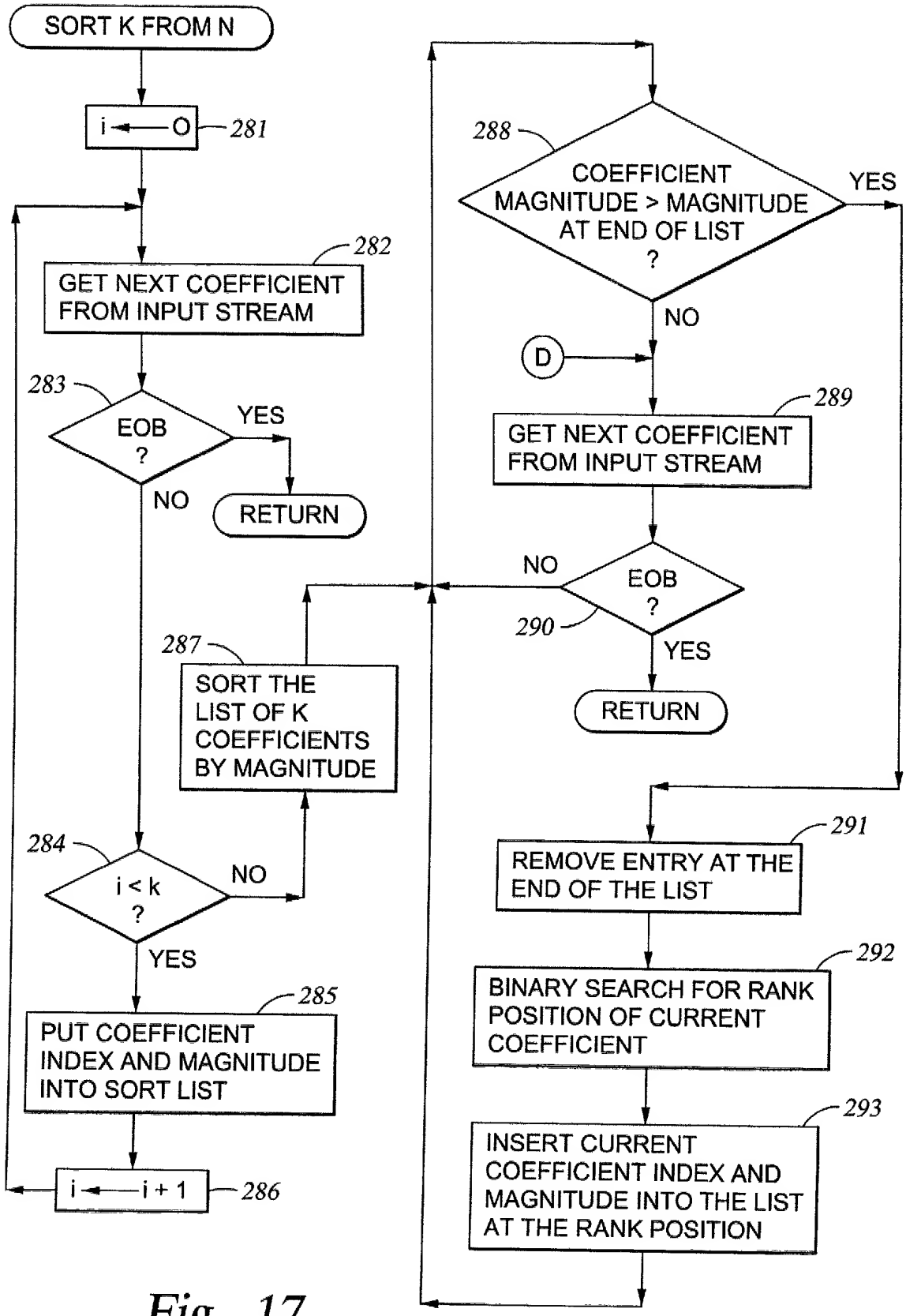

SORT K FROM N
i ← 0
281
GET NEXT COEFFICIENT FROM INPUT STREAM
282
EOB ?
283
YES
RETURN
NO
284
i < k ?
NO
YES
SORT THE LIST OF K COEFFICIENTS BY MAGNITUDE
287
PUT COEFFICIENT INDEX AND MAGNITUDE INTO SORT LIST
285
i ← i + 1
286
COEFFICIENT MAGNITUDE > MAGNITUDE AT END OF LIST ?
288
YES
NO
D
GET NEXT COEFFICIENT FROM INPUT STREAM
289
EOB ?
290
NO
YES
RETURN
REMOVE ENTRY AT THE END OF THE LIST
291
BINARY SEARCH FOR RANK POSITION OF CURRENT COEFFICIENT
292
INSERT CURRENT COEFFICIENT INDEX AND MAGNITUDE INTO THE LIST AT THE RANK POSITION
293

Fig. 17

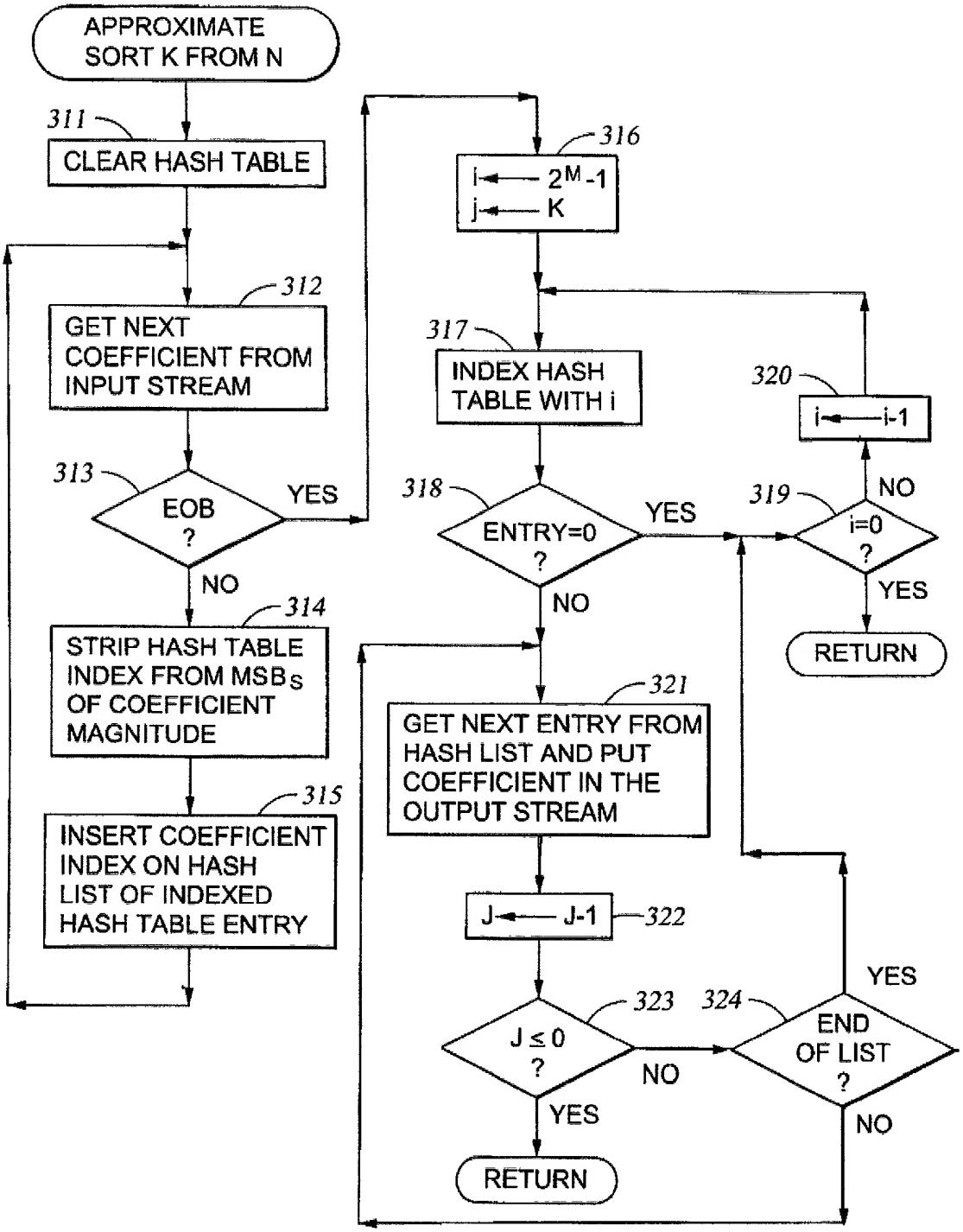

APPROXIMATE SORT K FROM N
311
CLEAR HASH TABLE
312
GET NEXT COEFFICIENT FROM INPUT STREAM
313
EOB ?
YES
NO
314
STRIP HASH TABLE INDEX FROM MSBs OF COEFFICIENT MAGNITUDE
315
INSERT COEFFICIENT INDEX ON HASH LIST OF INDEXED HASH TABLE ENTRY
316
i ← 2^M -1
j ← K
317
INDEX HASH TABLE WITH i
318
ENTRY=0 ?
YES
NO
319
i=0 ?
NO
YES
320
i ← i-1
RETURN
321
GET NEXT ENTRY FROM HASH LIST AND PUT COEFFICIENT IN THE OUTPUT STREAM
J ← J-1
322
323
J ≤ 0 ?
NO
YES
324
END OF LIST ?
YES
NO
RETURN

Fig. 19

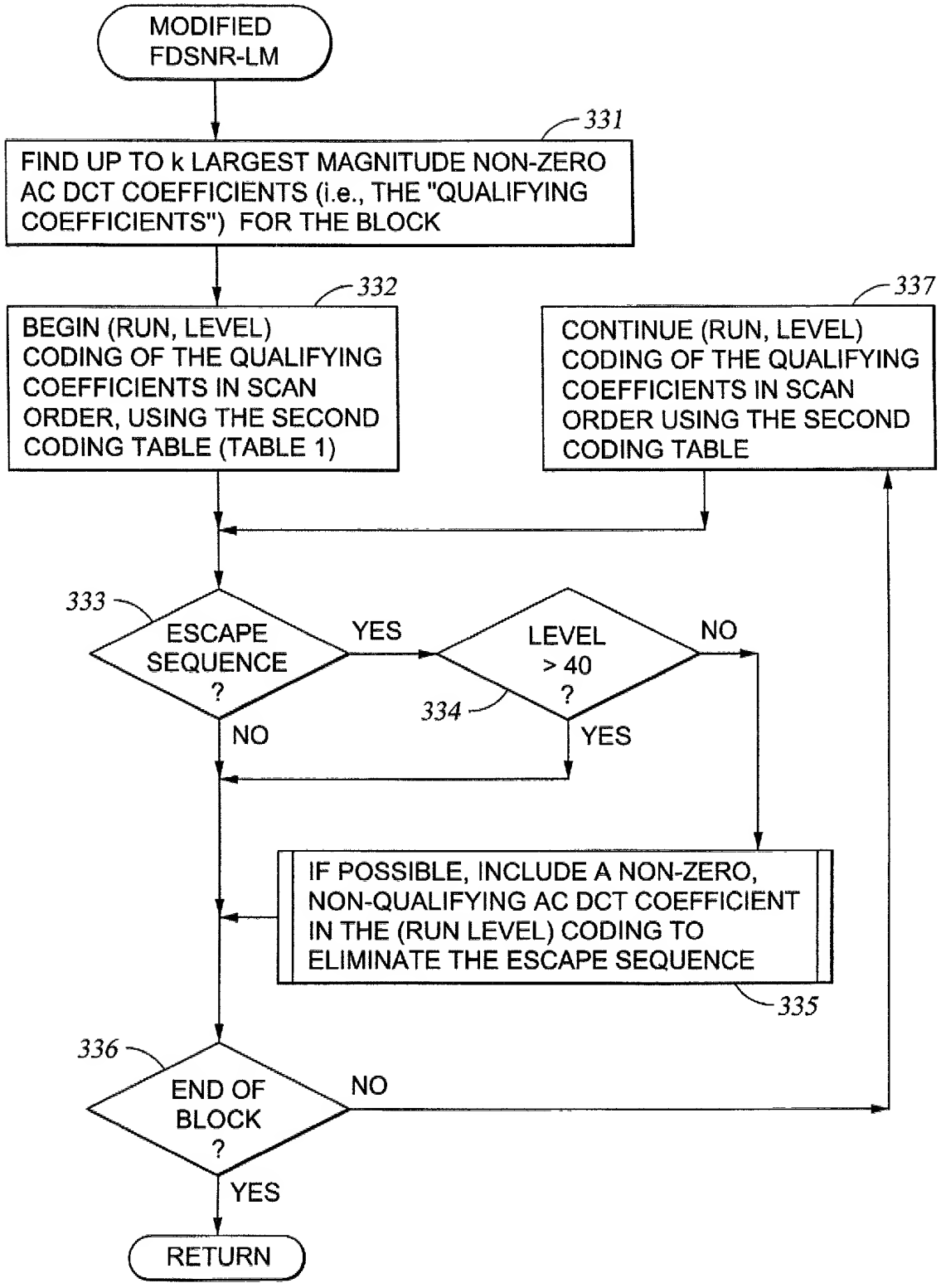
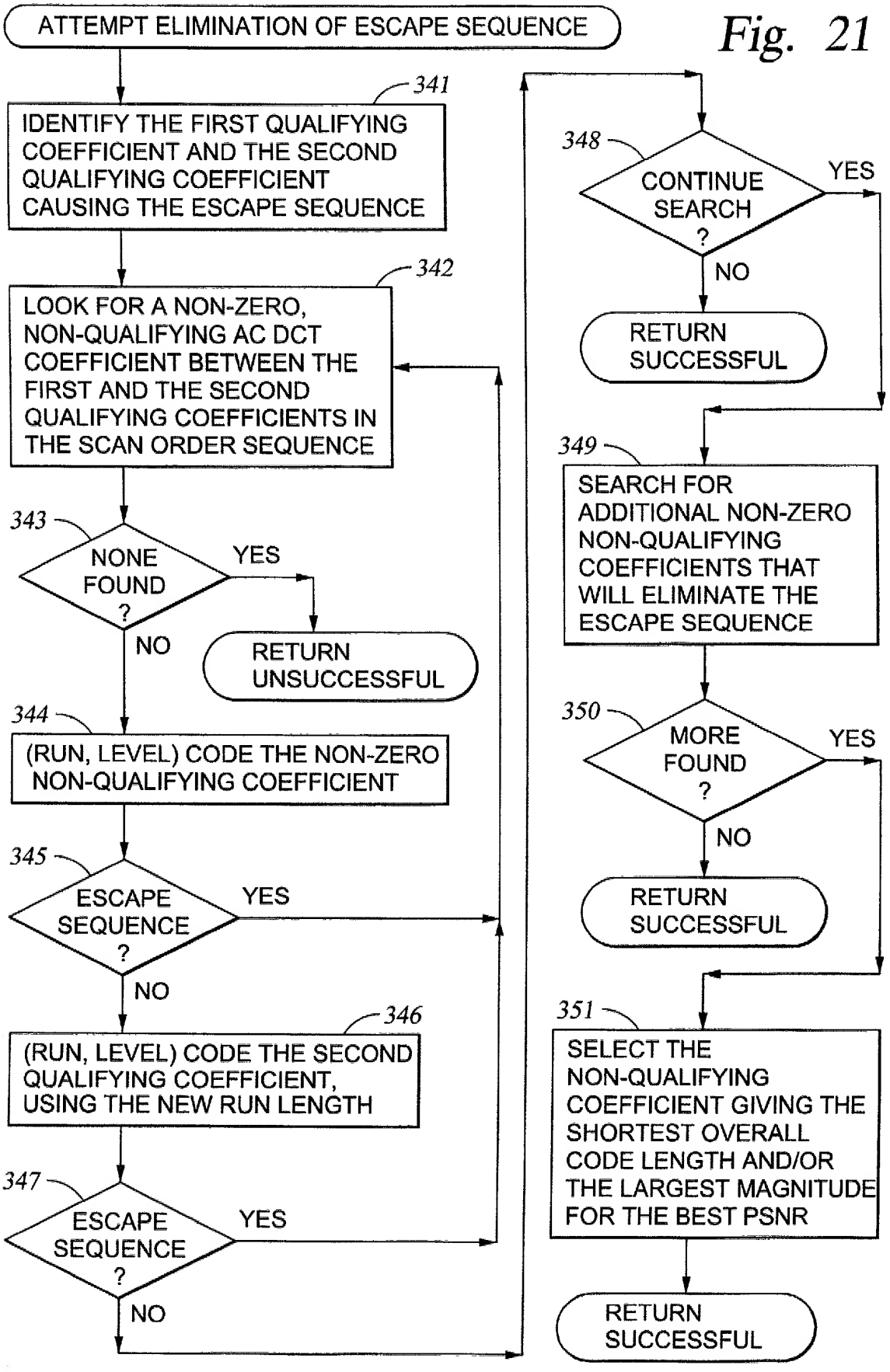

MODIFIED FDSNR-LM
331
FIND UP TO k LARGEST MAGNITUDE NON-ZERO AC DCT COEFFICIENTS (i.e., THE "QUALIFYING COEFFICIENTS") FOR THE BLOCK
332
BEGIN (RUN, LEVEL) CODING OF THE QUALIFYING COEFFICIENTS IN SCAN ORDER, USING THE SECOND CODING TABLE (TABLE 1)
337
CONTINUE (RUN, LEVEL) CODING OF THE QUALIFYING COEFFICIENTS IN SCAN ORDER USING THE SECOND CODING TABLE
333
ESCAPE SEQUENCE ?
YES
LEVEL > 40 ?
NO
334
NO
YES
IF POSSIBLE, INCLUDE A NON-ZERO, NON-QUALIFYING AC DCT COEFFICIENT IN THE (RUN LEVEL) CODING TO ELIMINATE THE ESCAPE SEQUENCE
335
336
END OF BLOCK ?
NO
YES
RETURN

Fig. 20

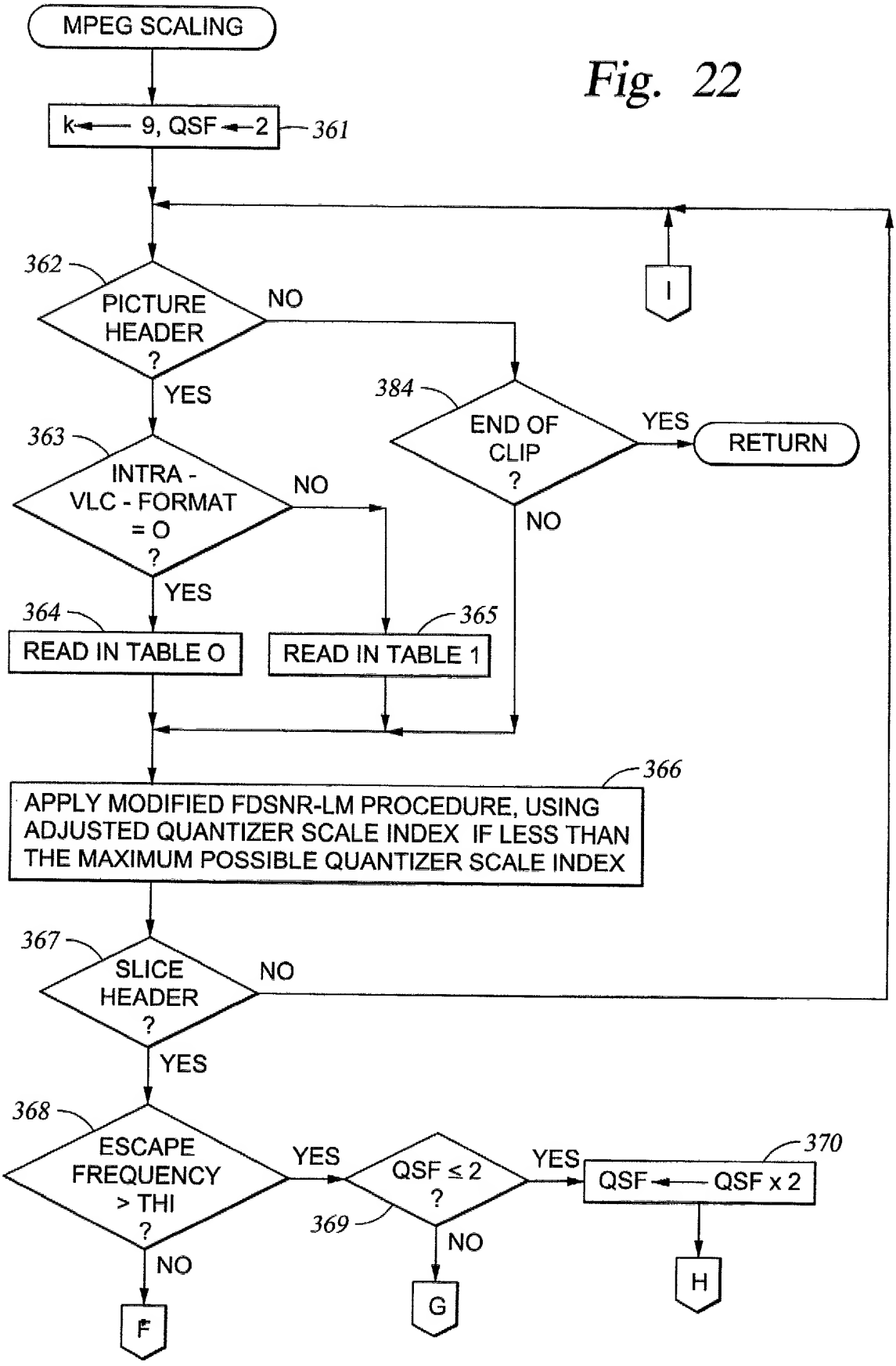
Patent Application Publication

Fig. 21



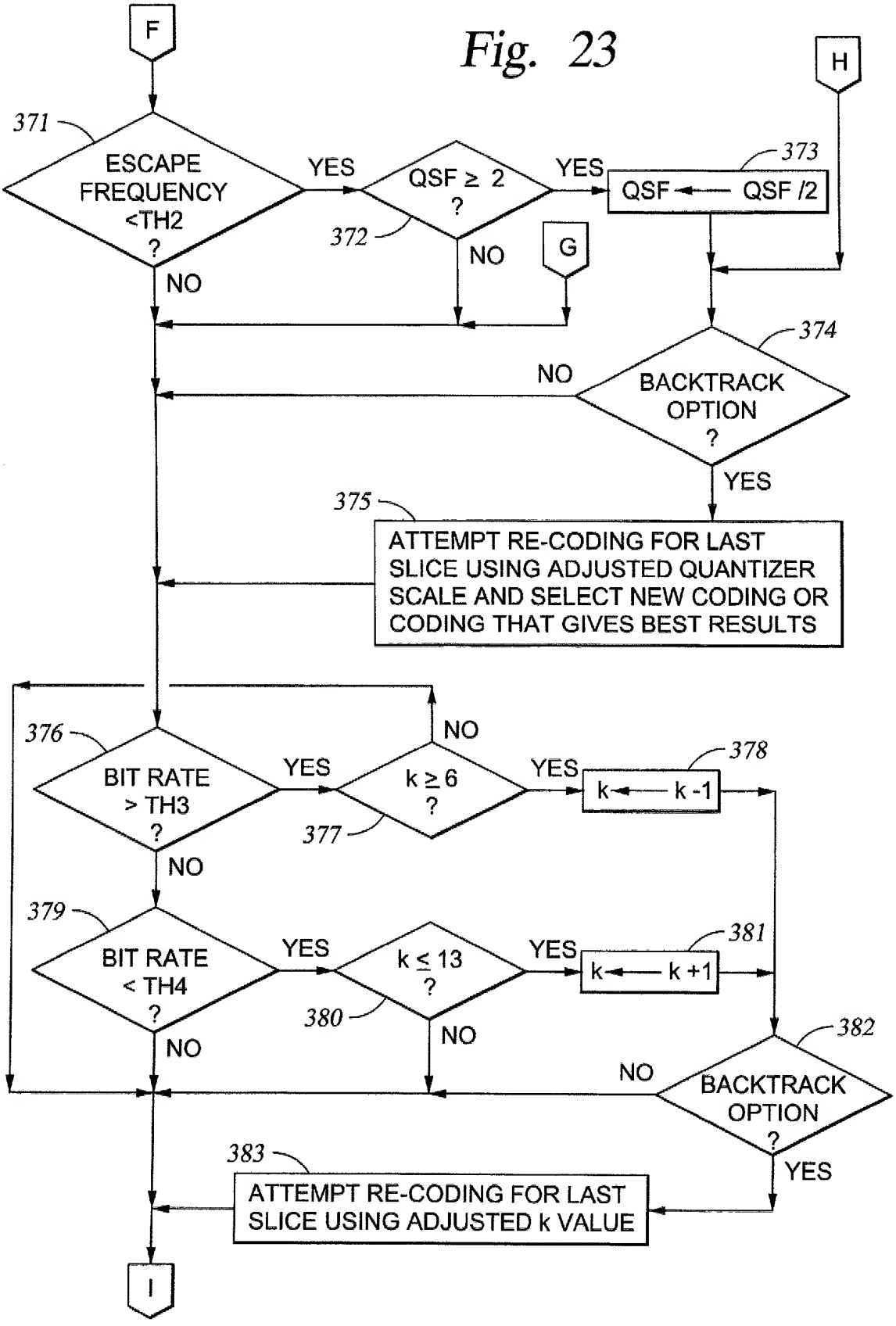
FOSTER-22556.0

Fig. 22



Patent Application Publication

Fig. 23



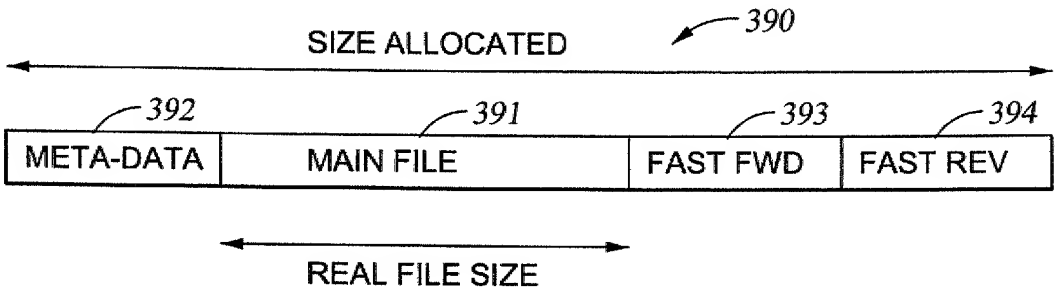

SIZE ALLOCATED
390
392
391
393
394
META-DATA
MAIN FILE
FAST FWD
FAST REV
REAL FILE SIZE

Fig. 24

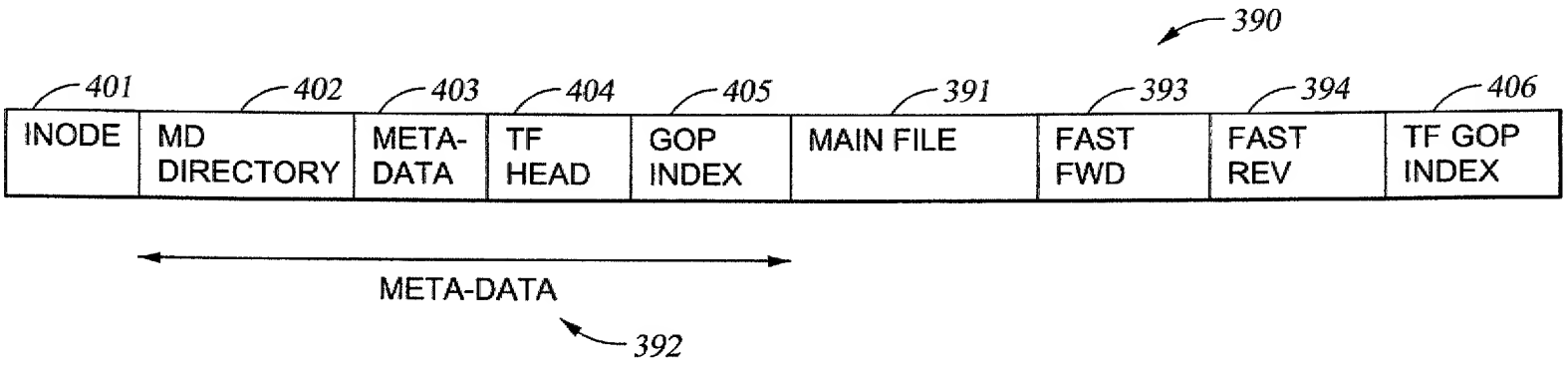

390
401
402
403
404
405
391
393
394
406
INODE
MD DIRECTORY
META-DATA
TF HEAD
GOP INDEX
MAIN FILE
FAST FWD
FAST REV
TF GOP INDEX
META-DATA
392

Fig. 25

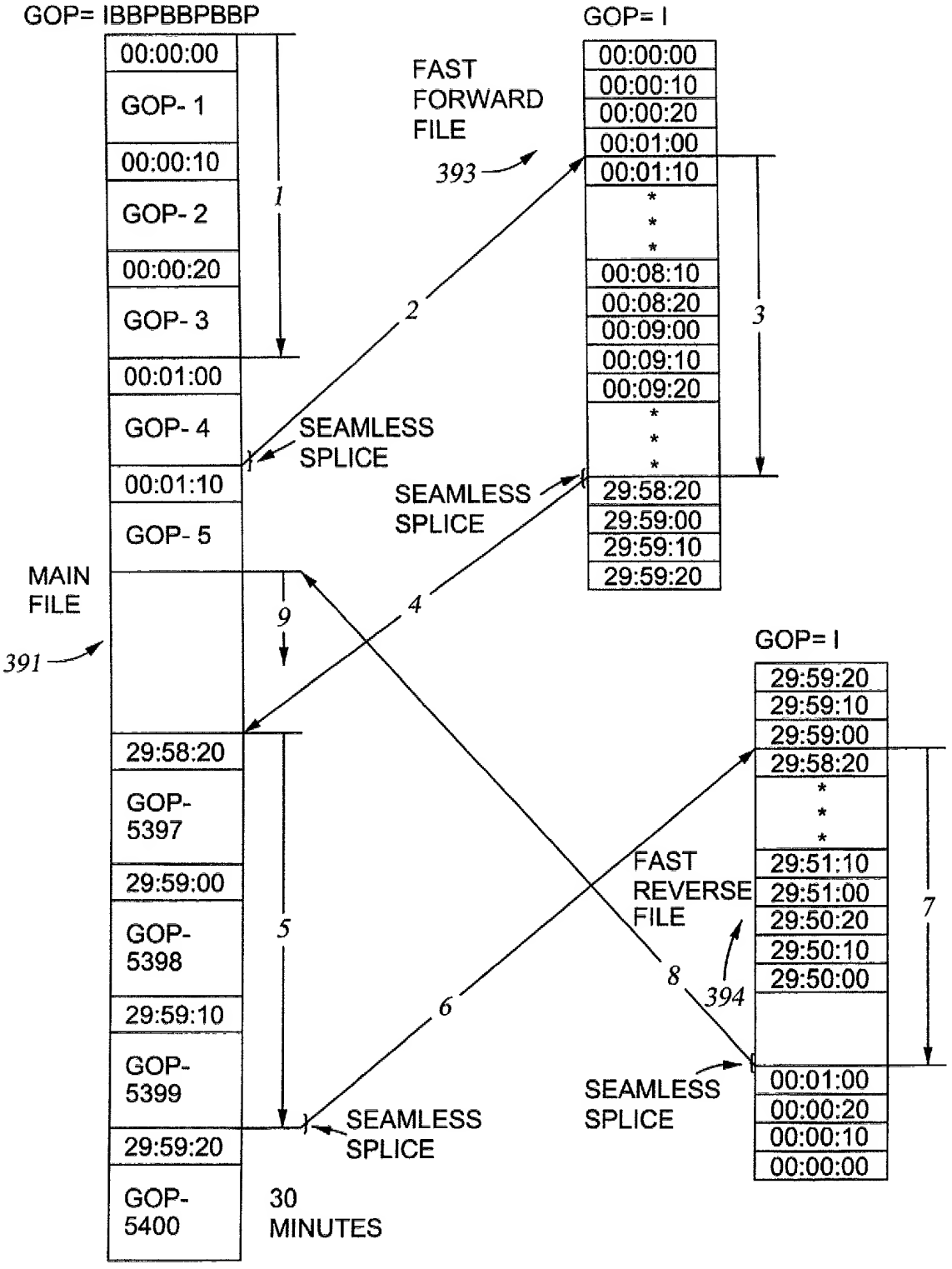

GOP= IBBPBBPBBP
00:00:00
GOP- 1
00:00:10
GOP- 2
00:00:20
GOP- 3
00:01:00
GOP- 4
00:01:10
GOP- 5
MAIN FILE
391
29:58:20
GOP- 5397
29:59:00
GOP- 5398
29:59:10
GOP- 5399
29:59:20
GOP- 5400
30 MINUTES
1
2
SEAMLESS SPLICE
FAST FORWARD FILE
393
GOP= I
00:00:00
00:00:10
00:00:20
00:01:00
00:01:10
00:08:10
00:08:20
00:09:00
00:09:10
00:09:20
29:58:20
29:59:00
29:59:10
29:59:20
3
SEAMLESS SPLICE
4
9
5
6
GOP= I
29:59:20
29:59:10
29:59:00
29:58:20
29:51:10
29:51:00
29:50:20
29:50:10
29:50:00
00:01:00
00:00:20
00:00:10
00:00:00
FAST REVERSE FILE
394
8
7
SEAMLESS SPLICE

Fig. 26A

Fig. 26B

1- Play from start 1 sec
2- Pause
3- Fast Forward to 29 min
4- Pause
5- Play 1 sec
6- Pause
7- Fast Reverse to 1 sec
8- Pause
9- Play Normal

	READ	WRITE
COPY OF THE ASSET WITH ALL THE DATA	EMPEG2	EMPEG2
COPY ONLY THE MAIN ASSET	RAW	MPEG2
ARCHIVE	EMPEG2	EMPEG2
PLAY	MPEG2	
RECORD		MPEG2

Fig. 27

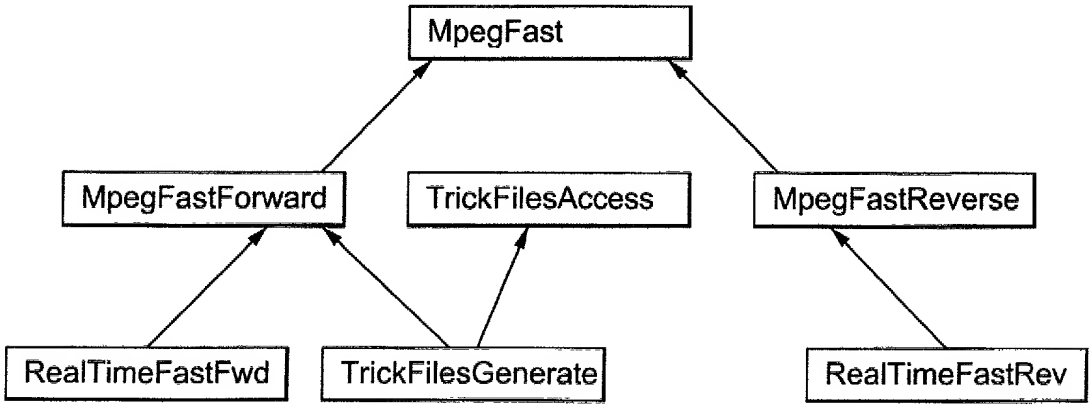


Fig. 28

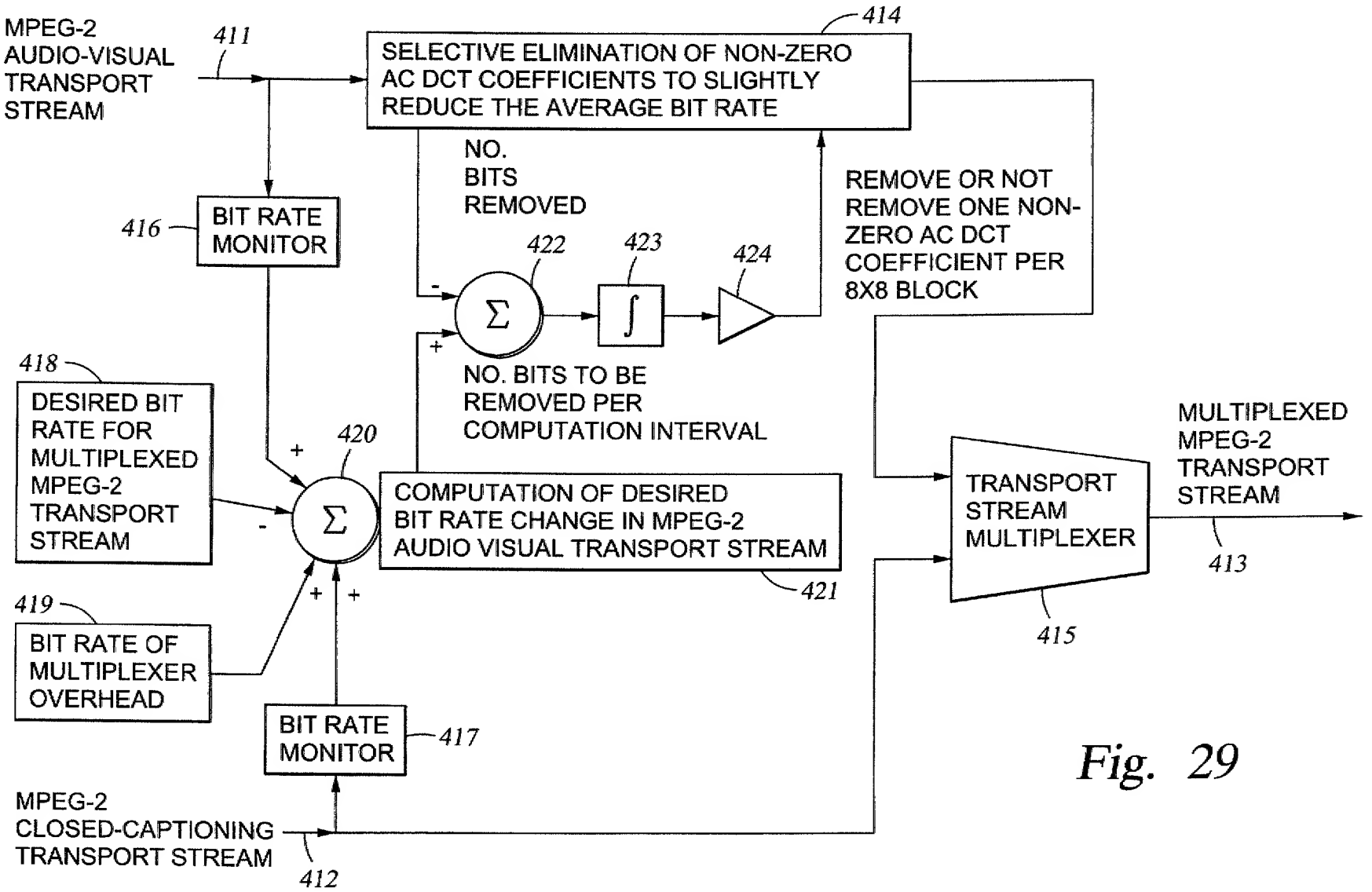

MPEG-2
AUDIO-VISUAL
TRANSPORT
STREAM
411
SELECTIVE ELIMINATION OF NON-ZERO
AC DCT COEFFICIENTS TO SLIGHTLY
REDUCE THE AVERAGE BIT RATE
414
NO.
BITS
REMOVED
REMOVE OR NOT
REMOVE ONE NON-
ZERO AC DCT
COEFFICIENT PER
8X8 BLOCK
416
BIT RATE
MONITOR
422
423
424
Σ
∫
NO. BITS TO BE
REMOVED PER
COMPUTATION INTERVAL
418
DESIRED BIT
RATE FOR
MULTIPLEXED
MPEG-2
TRANSPORT
STREAM
420
COMPUTATION OF DESIRED
BIT RATE CHANGE IN MPEG-2
AUDIO VISUAL TRANSPORT STREAM
421
TRANSPORT
STREAM
MULTIPLEXER
MULTIPLEXED
MPEG-2
TRANSPORT
STREAM
413
415
419
BIT RATE OF
MULTIPLEXER
OVERHEAD
BIT RATE
MONITOR
417
MPEG-2
CLOSED-CAPTIONING
TRANSPORT STREAM
412

Fig. 29

PCT/SG2005/000450

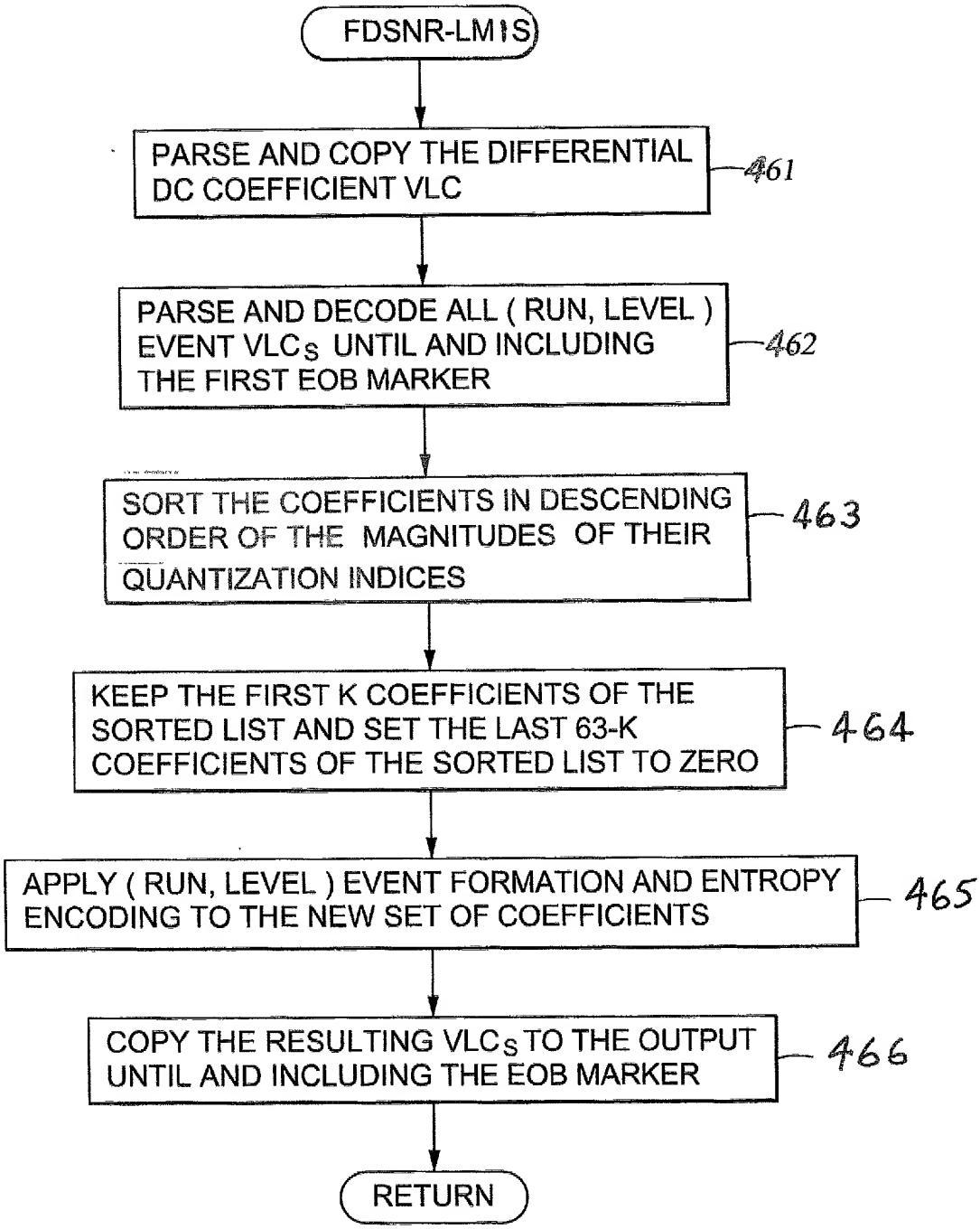


FIG. 30

Comparison of LMCS and LMIS procedures for qsv=2, 4, 6, and 8

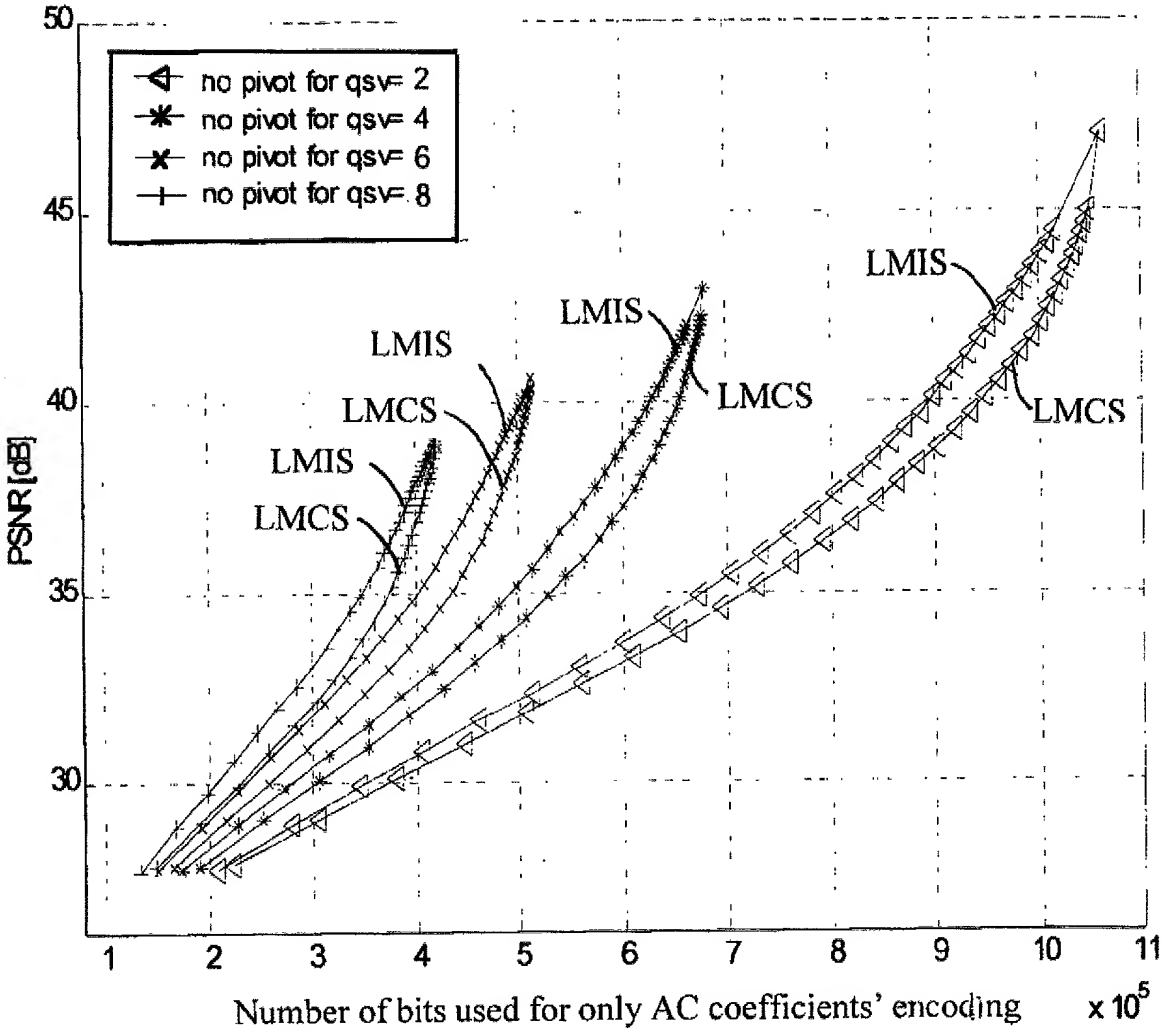


FIG. 31

Comparison of LMCS and LMIS procedures for qsv=12, 16, 20, and 24

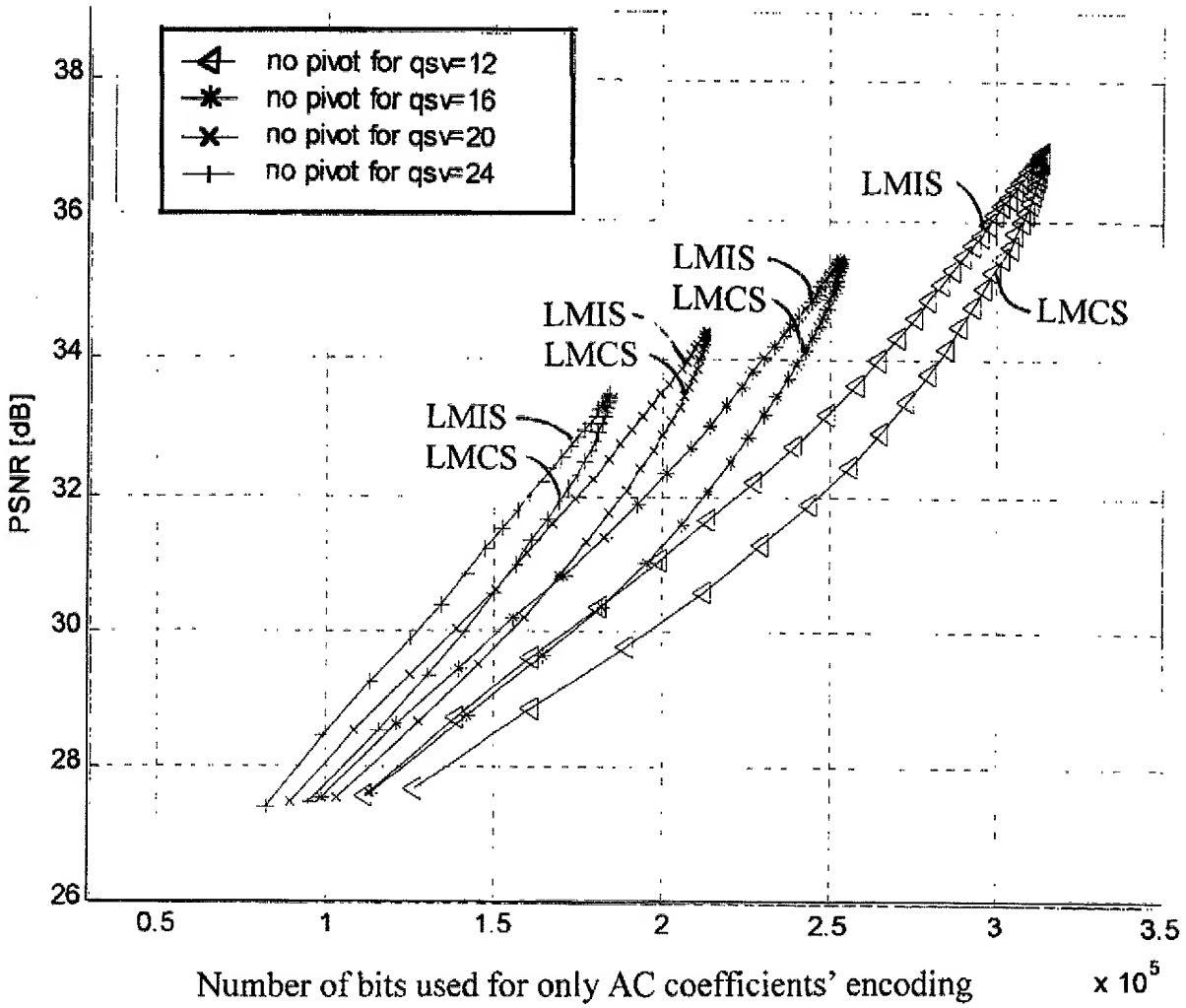


FIG. 32

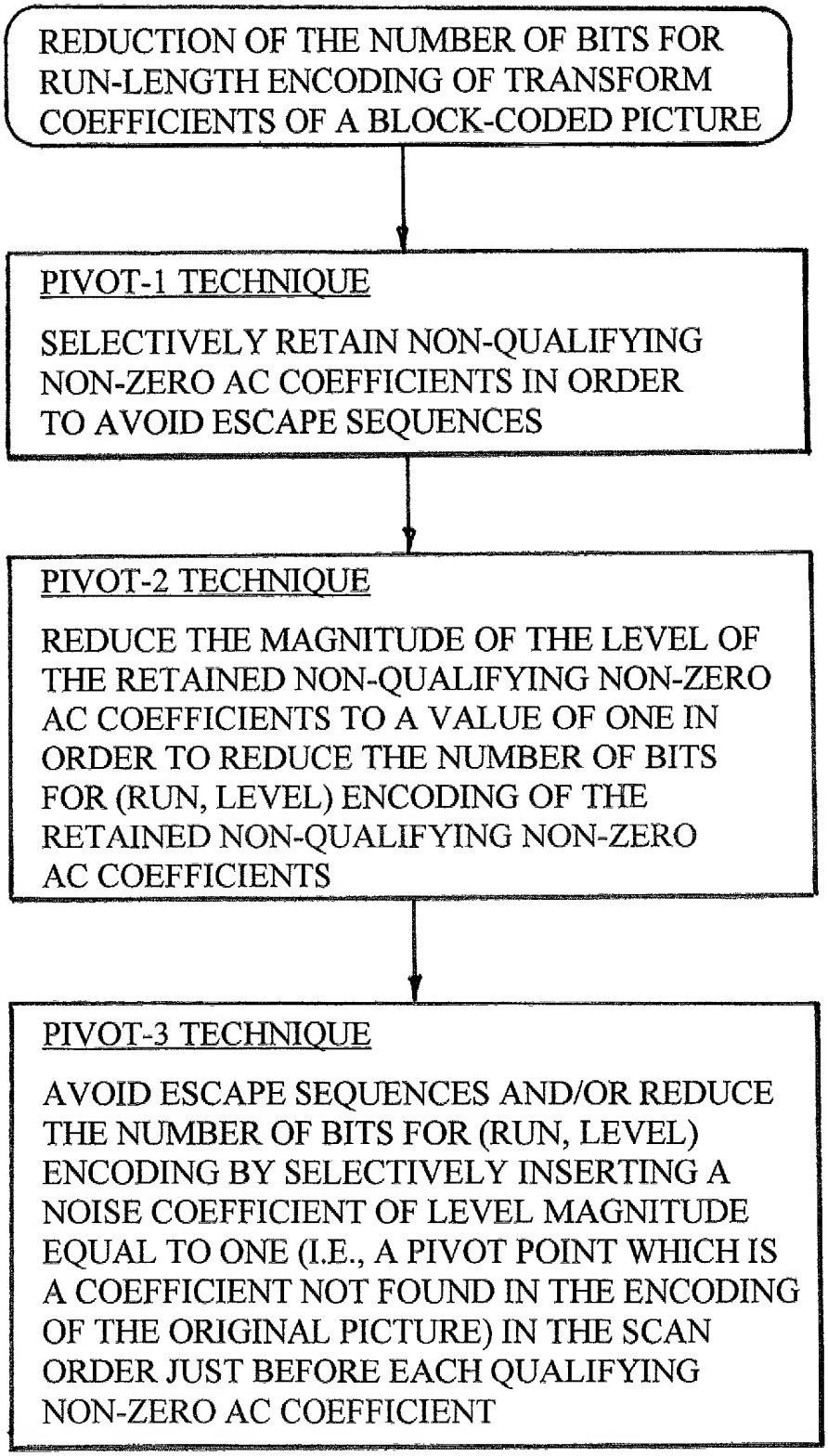

REDUCTION OF THE NUMBER OF BITS FOR RUN-LENGTH ENCODING OF TRANSFORM COEFFICIENTS OF A BLOCK-CODED PICTURE
PIVOT-1 TECHNIQUE
SELECTIVELY RETAIN NON-QUALIFYING NON-ZERO AC COEFFICIENTS IN ORDER TO AVOID ESCAPE SEQUENCES
PIVOT-2 TECHNIQUE
REDUCE THE MAGNITUDE OF THE LEVEL OF THE RETAINED NON-QUALIFYING NON-ZERO AC COEFFICIENTS TO A VALUE OF ONE IN ORDER TO REDUCE THE NUMBER OF BITS FOR (RUN, LEVEL) ENCODING OF THE RETAINED NON-QUALIFYING NON-ZERO AC COEFFICIENTS
PIVOT-3 TECHNIQUE
AVOID ESCAPE SEQUENCES AND/OR REDUCE THE NUMBER OF BITS FOR (RUN, LEVEL) ENCODING BY SELECTIVELY INSERTING A NOISE COEFFICIENT OF LEVEL MAGNITUDE EQUAL TO ONE (I.E., A PIVOT POINT WHICH IS A COEFFICIENT NOT FOUND IN THE ENCODING OF THE ORIGINAL PICTURE) IN THE SCAN ORDER JUST BEFORE EACH QUALIFYING NON-ZERO AC COEFFICIENT

FIG. 33

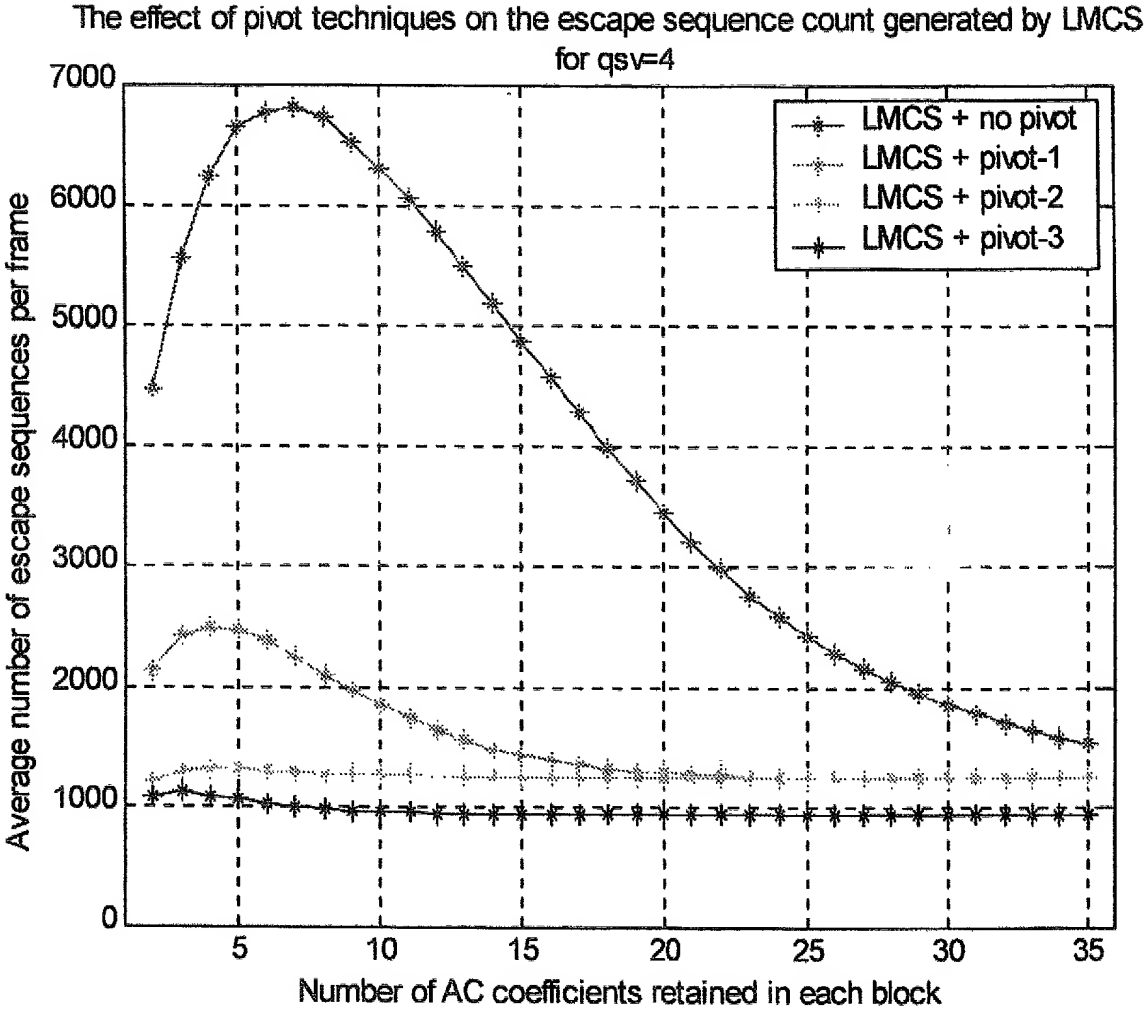

The effect of pivot techniques on the escape sequence count generated by LMCS for qsv=4
Average number of escape sequences per frame
Number of AC coefficients retained in each block
LMCS + no pivot
LMCS + pivot-1
LMCS + pivot-2
LMCS + pivot-3
0
1000
2000
3000
4000
5000
6000
7000
5
10
15
20
25
30
35

FIG. 34

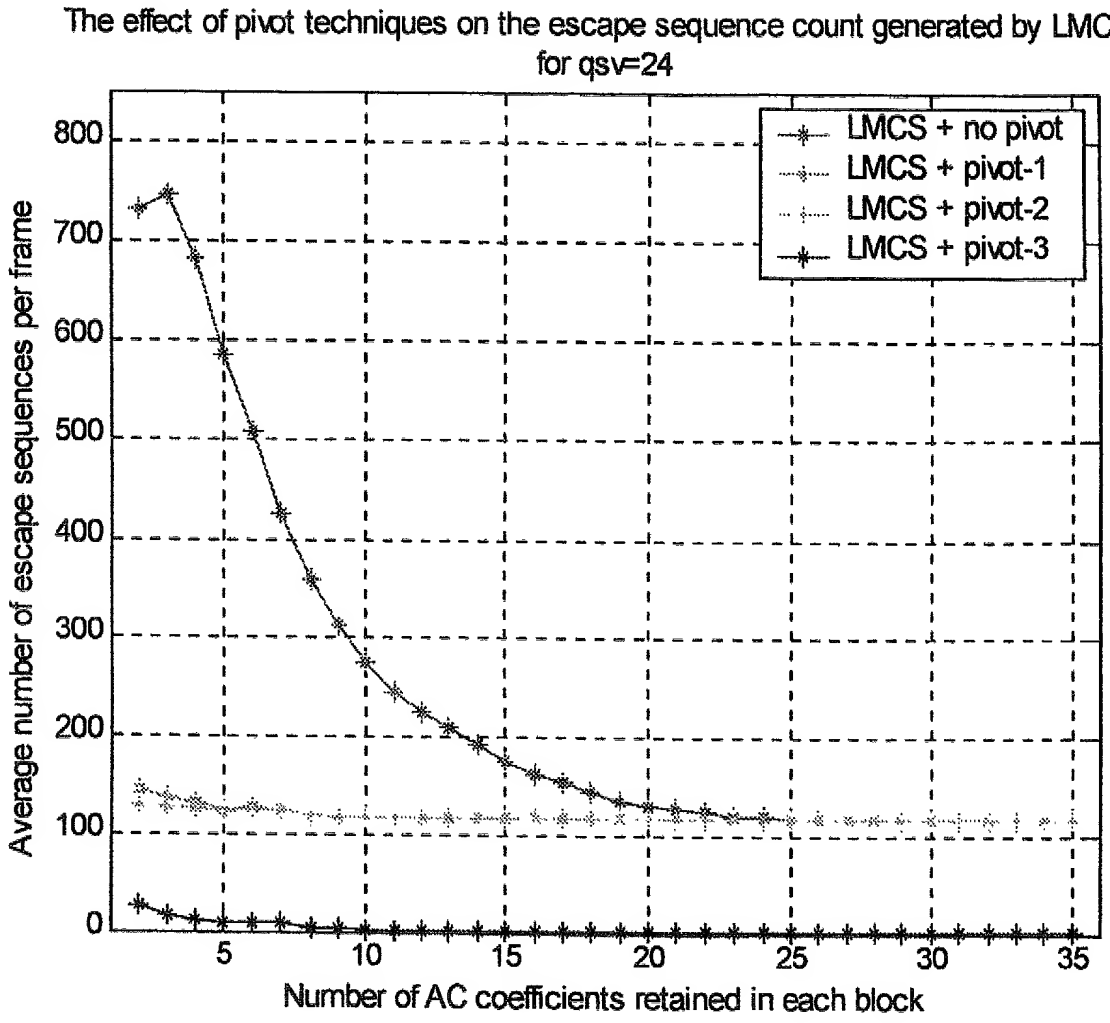

The effect of pivot techniques on the escape sequence count generated by LMCS for qsv=24
LMCS + no pivot
LMCS + pivot-1
LMCS + pivot-2
LMCS + pivot-3
Average number of escape sequences per frame
Number of AC coefficients retained in each block
0
100
200
300
400
500
600
700
800
5
10
15
20
25
30
35

FIG. 35

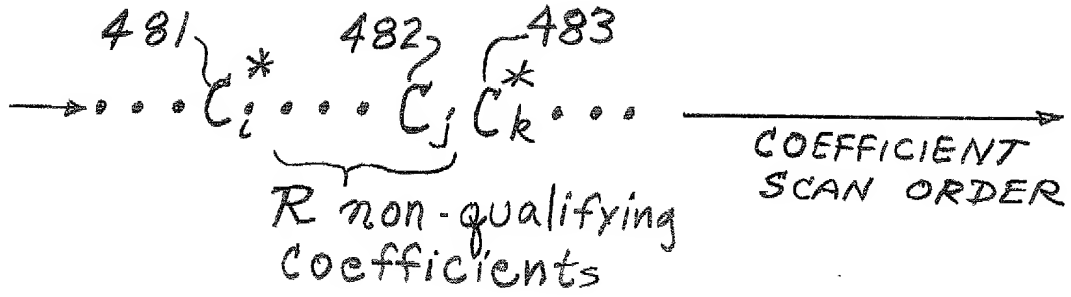


FIG. 36

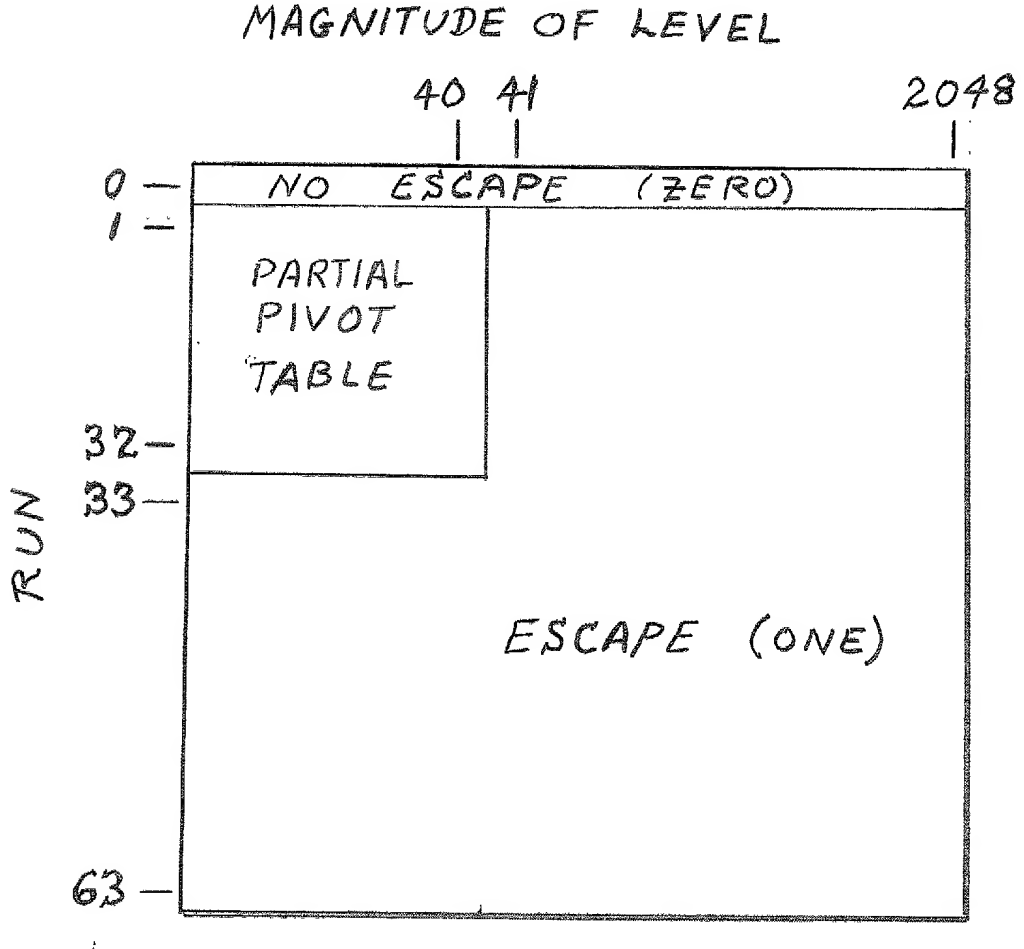


FIG. 37

US 6,556,625 B2

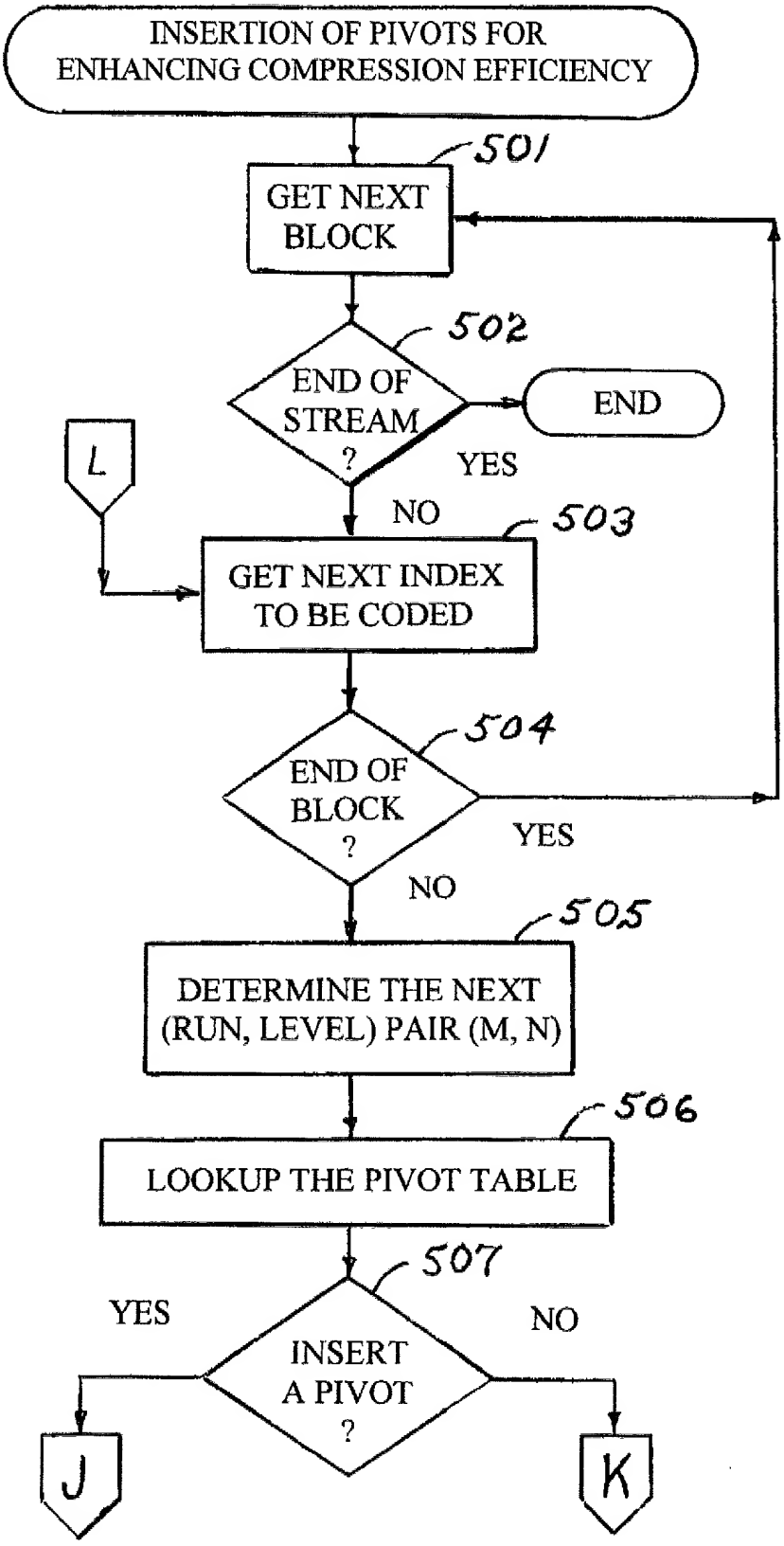

INSERTION OF PIVOTS FOR ENHANCING COMPRESSION EFFICIENCY
501
GET NEXT BLOCK
502
END OF STREAM ?
END
YES
NO
L
503
GET NEXT INDEX TO BE CODED
504
END OF BLOCK ?
YES
NO
505
DETERMINE THE NEXT (RUN, LEVEL) PAIR (M, N)
506
LOOKUP THE PIVOT TABLE
507
YES
NO
INSERT A PIVOT ?
J
K

FIG. 38

EP 0 954 954 A1

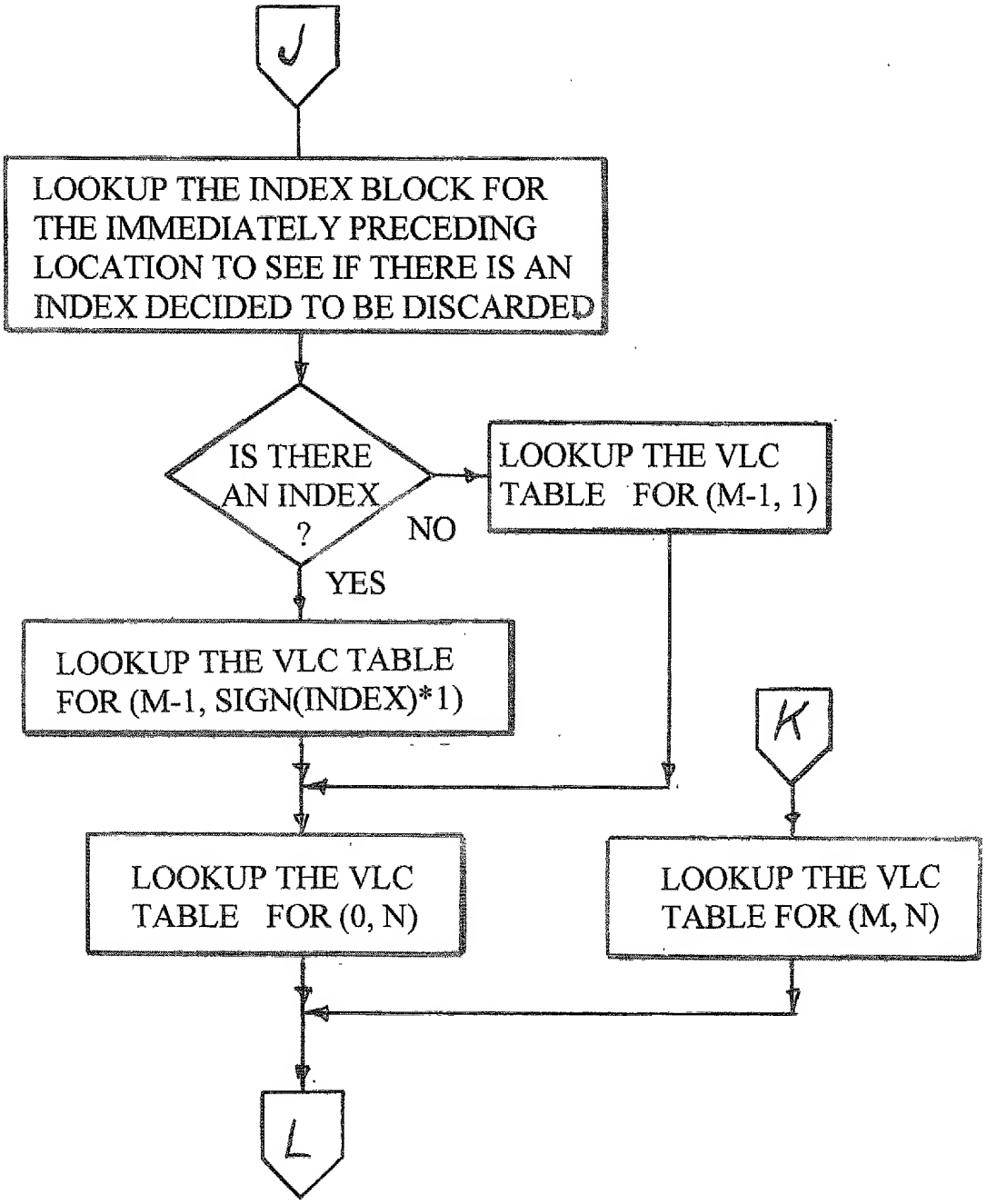


FIG. 39

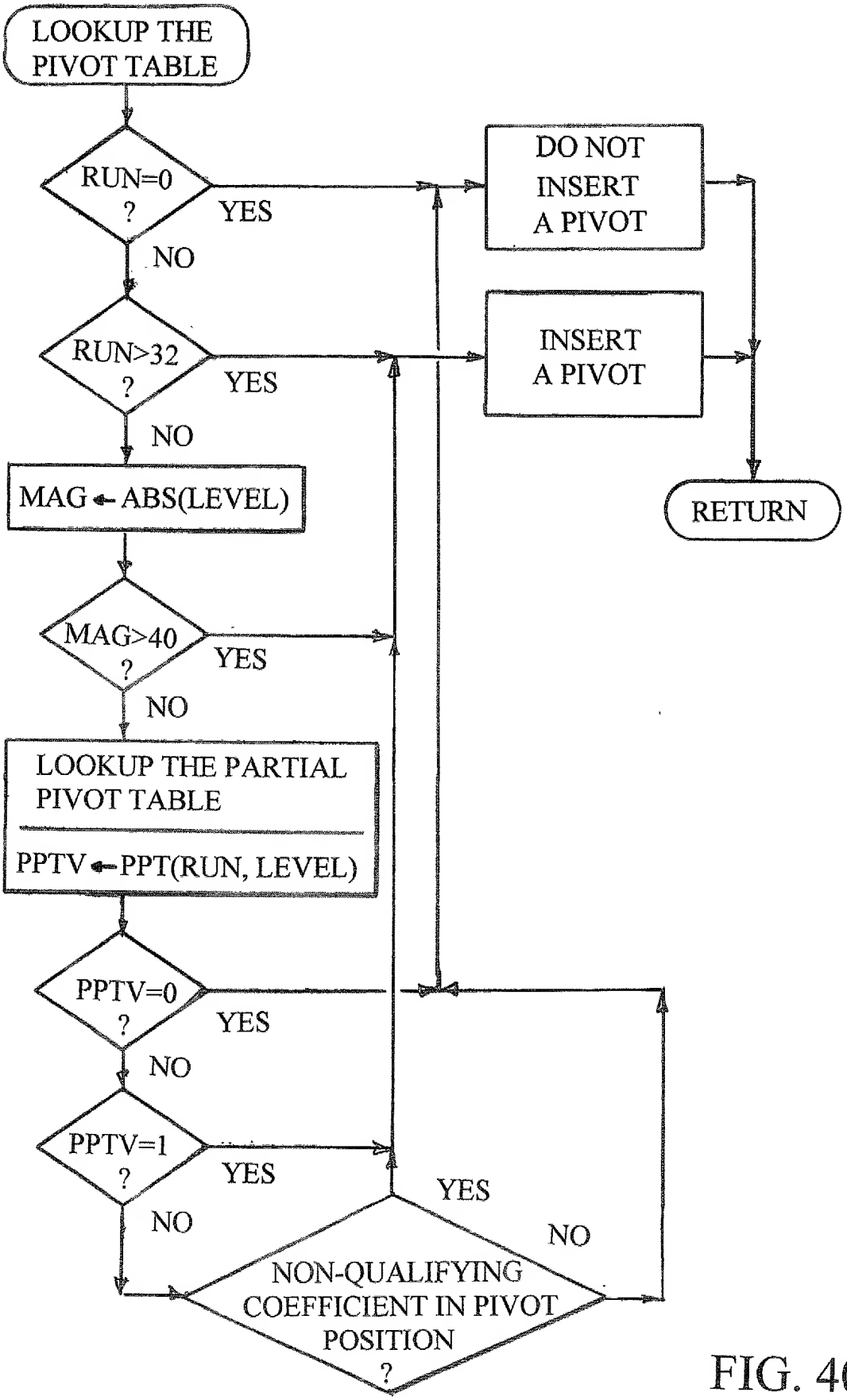

LOOKUP THE PIVOT TABLE
RUN=0 ?
YES
NO
DO NOT INSERT A PIVOT
RUN>32 ?
YES
NO
INSERT A PIVOT
RETURN
MAG ← ABS(LEVEL)
MAG>40 ?
YES
NO
LOOKUP THE PARTIAL PIVOT TABLE
PPTV ← PPT(RUN, LEVEL)
PPTV=0 ?
YES
NO
PPTV=1 ?
YES
NO
YES
NO
NON-QUALIFYING COEFFICIENT IN PIVOT POSITION ?

FIG. 40

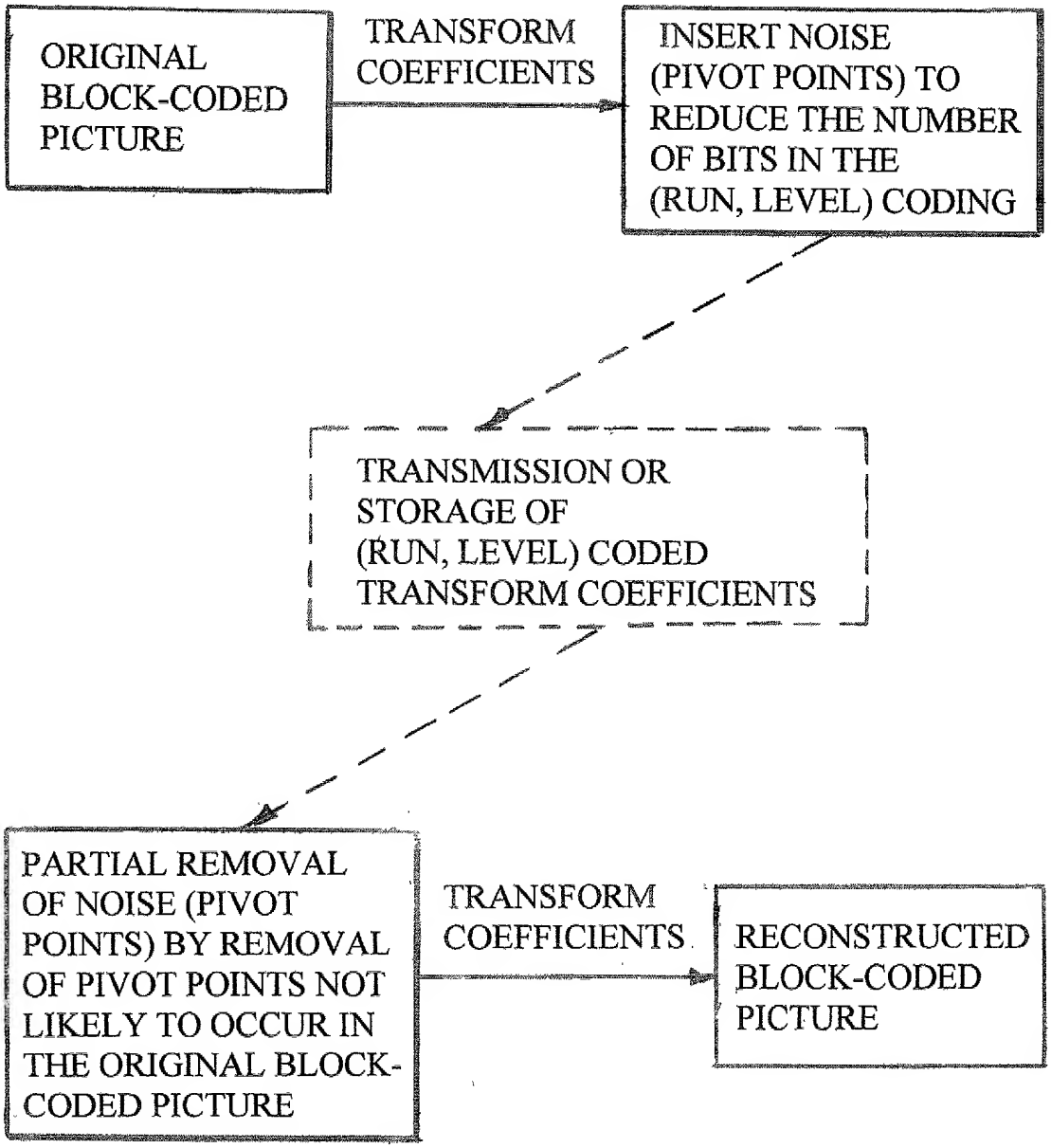


FIG. 41

US 6,954,501 B2

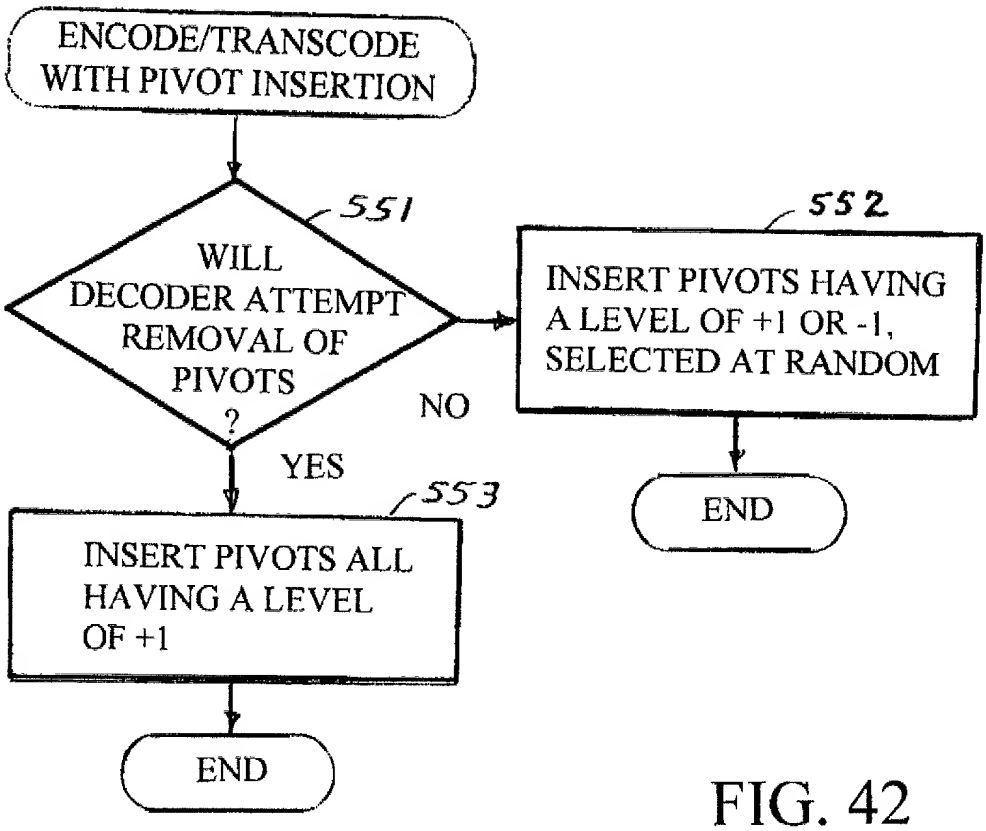

ENCODE/TRANSCODE WITH PIVOT INSERTION
551
WILL DECODER ATTEMPT REMOVAL OF PIVOTS ?
NO
YES
552
INSERT PIVOTS HAVING A LEVEL OF +1 OR -1, SELECTED AT RANDOM
END
553
INSERT PIVOTS ALL HAVING A LEVEL OF +1
END

FIG. 42

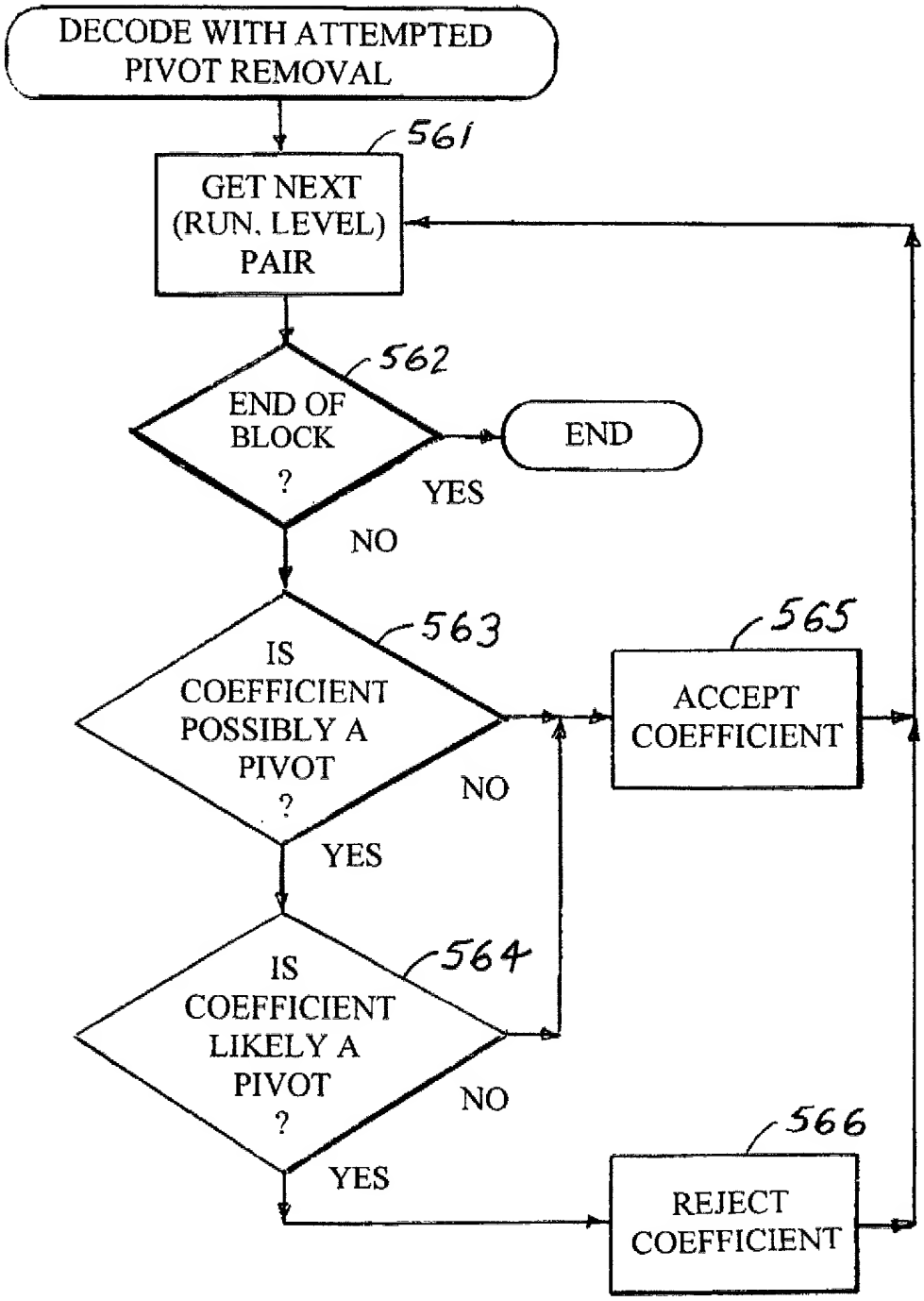

DECODE WITH ATTEMPTED PIVOT REMOVAL
561
GET NEXT (RUN, LEVEL) PAIR
562
END OF BLOCK ?
YES
END
NO
563
IS COEFFICIENT POSSIBLY A PIVOT ?
NO
YES
565
ACCEPT COEFFICIENT
564
IS COEFFICIENT LIKELY A PIVOT ?
NO
YES
566
REJECT COEFFICIENT

FIG. 43

EP 0 756 516 A2

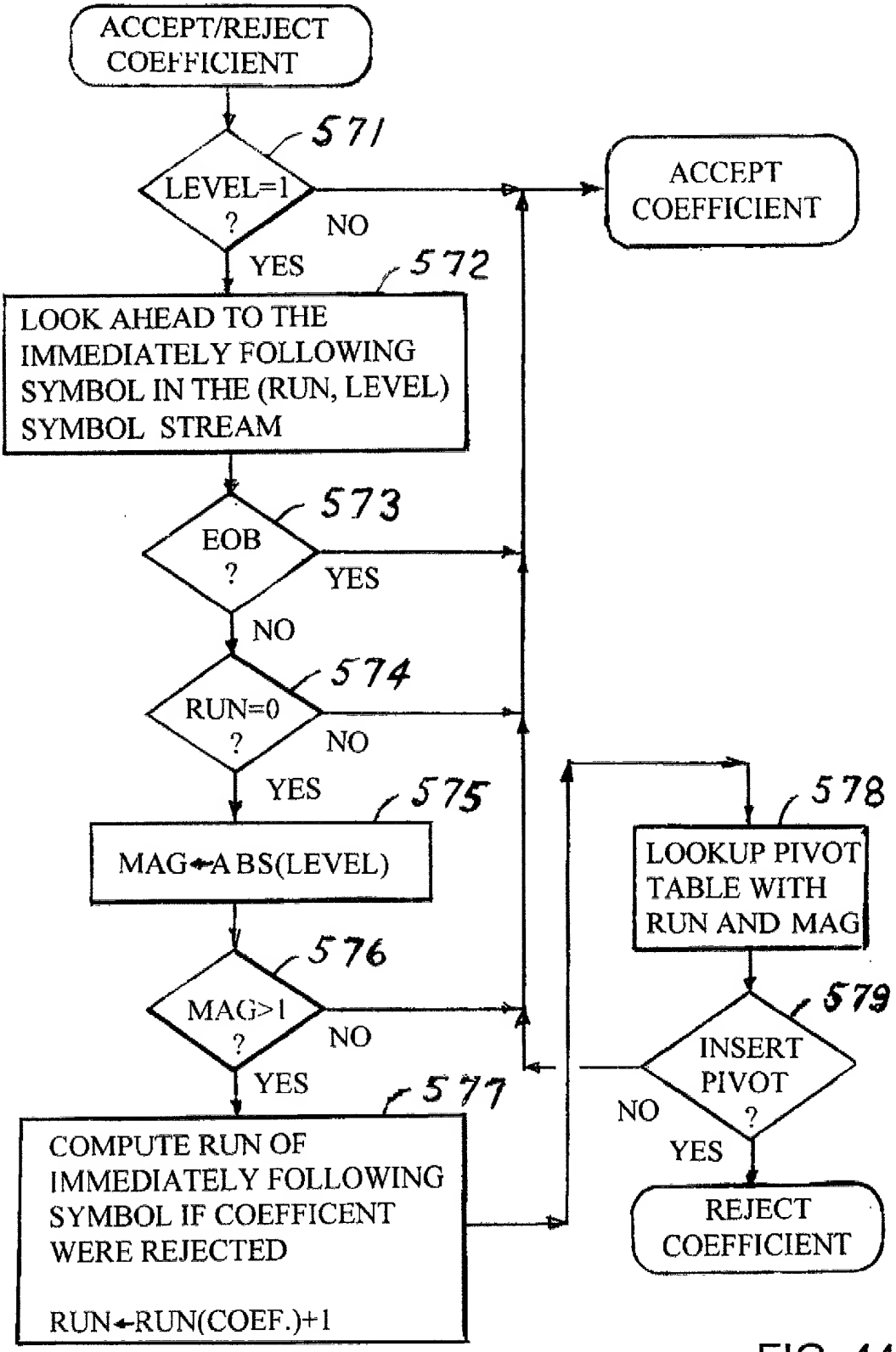


FIG. 44

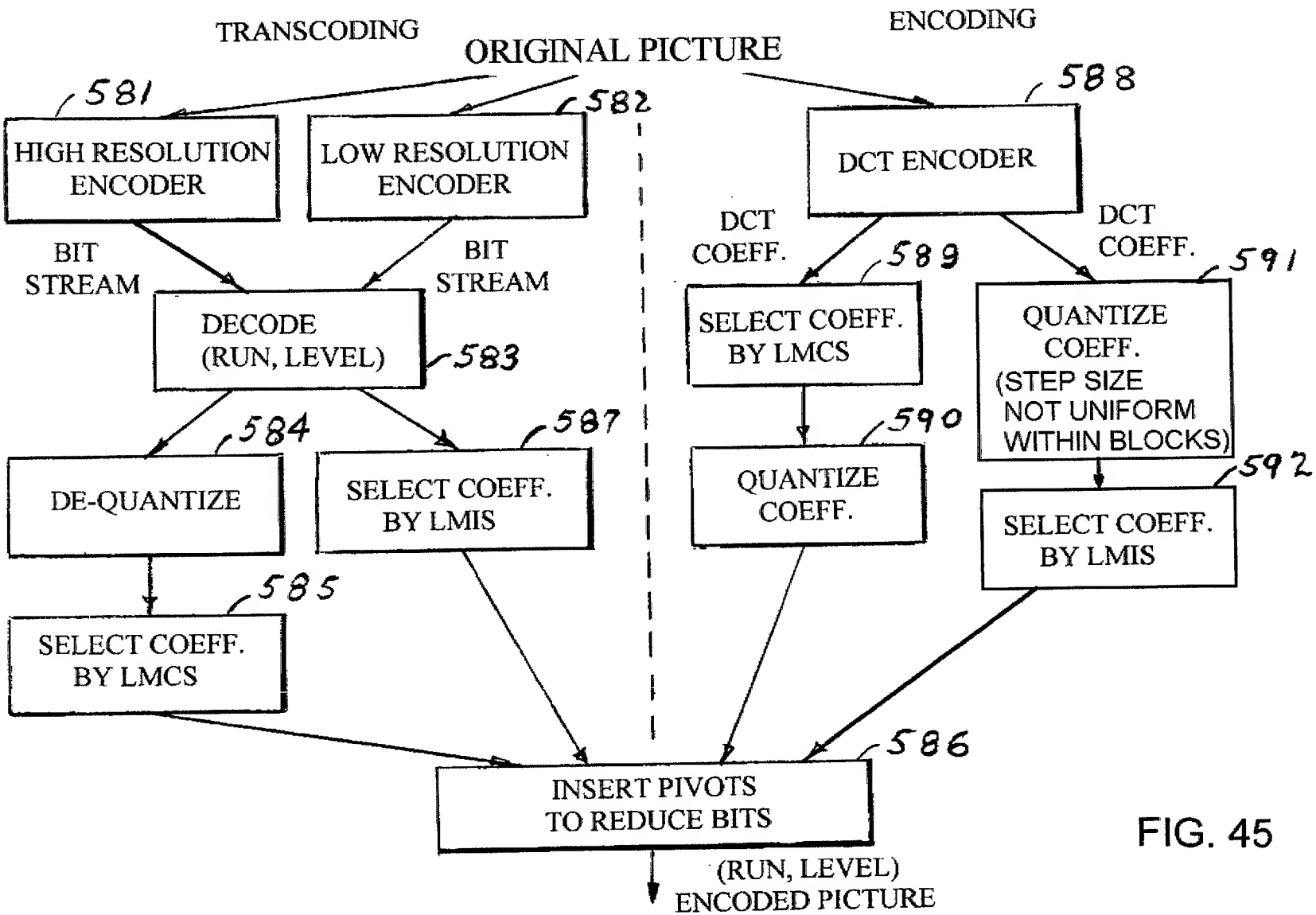

TRANSCODING
ENCODING
ORIGINAL PICTURE
581
582
588
HIGH RESOLUTION ENCODER
LOW RESOLUTION ENCODER
DCT ENCODER
BIT STREAM
BIT STREAM
DCT COEFF.
DCT COEFF.
589
591
DECODE (RUN, LEVEL)
583
SELECT COEFF. BY LMCS
QUANTIZE COEFF. (STEP SIZE NOT UNIFORM WITHIN BLOCKS)
584
587
590
592
DE-QUANTIZE
SELECT COEFF. BY LMIS
QUANTIZE COEFF.
SELECT COEFF. BY LMIS
585
SELECT COEFF. BY LMCS
586
INSERT PIVOTS TO REDUCE BITS
(RUN, LEVEL) ENCODED PICTURE

FIG. 45